AD-A034 243 MCDERMOTT (J RAY) CO INC NEW ORLEANS LA F/G 13/10

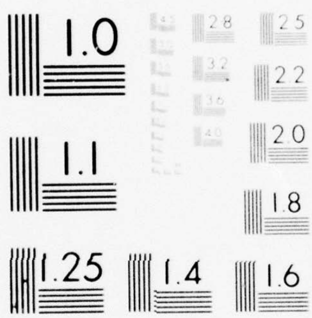
ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM. VOLUME 2. --ETC(U)

1966 DA-44-009-AMC-841(T)

UNCLASSIFIED NL

1 OF 2

AD A034243


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

NG SYSTEM

ion for
White Section ☑
Buff Section ☐
...NCED ☐
...CATION ....
....
DISTRIBUTION/AVAILABILITY CODES
AVAIL. and/or SPECIAL

A

ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM

VOLUME 2

APPENDIX A
TO
FINAL REPORT, on Phase 1.

Contract No. DA-44-009-AMC-841(T)

U. S. ARMY
ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES
FORT BELVOIR, VIRGINIA

J. RAY McDERMOTT & CO., INC.
NEW ORLEANS, LOUISIANA

106 p.

1966

222950

ENGINEERING

DESIGN CALCULATIONS

MONO-MOORING SYSTEM

VOLUME 2

APPENDIX A
to
FINAL REPORT

Contract No. DA-44-009-AMC-841(T)

U. S. ARMY MATERIEL COMMAND

ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES

FORT BELVOIR, VIRGINIA

J. RAY McDERMOTT & CO., INC.
Saratoga Building
New Orleans, Louisiana

1966

' RAY McDERMOTT & CO., INC.
ENGINEERING DEPARTMENT - COMPUTATION SHEET

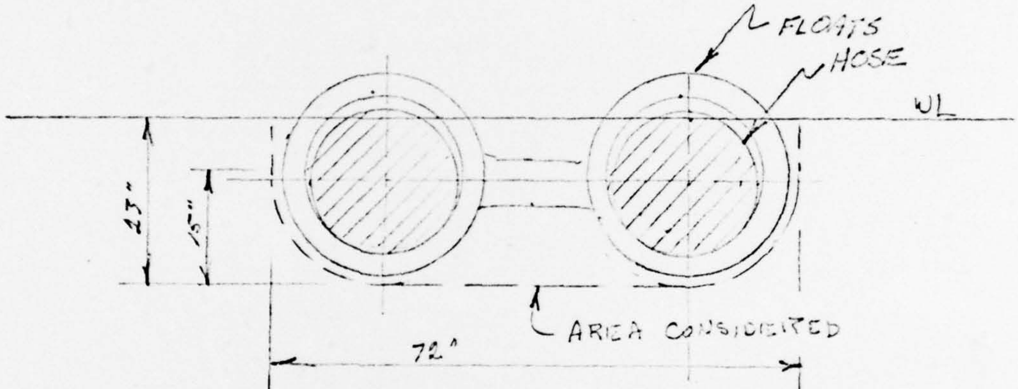
SHEET No. 1

COMPANY USA / ERDL
SUBJECT Mono-Mooring System
DRAWING No. ________ COMPUTER GRS ________ CHKD. BY ________ DATE 4-22 19 65

DRAG FORCE OF HOSE

FILE 6-8.1

$V = 4$ KT
$v = 1.69 \times 4 = 6.75$ ft/sec
v^2



CROSS SECTION OF HOSE

WETTED SURFACE /IN = 8 + 8 + π 15 + 42 =
16 + 47 + 42 = 105"
" " /FT $\cong$ = 9□

LENGTH = 700'

WETTED AREA = 9 × 700 = 6,300 □

IN FREE TEATHERED CONDITION

$R_e = \frac{vL}{\nu} = \frac{6.75 \times 700}{1.211 \times 10^{-5}} = 3900 \times 10^5 = 3.9 \times 10^8$

$C_f = 1.724 \times 10^{-3}$

$R = \frac{\rho}{2} C_f S v^2 = 1 \times 1.724 \times 10^{-3} \times 6.3 \times 10^3 \times 45.6 = 495^{\#}$

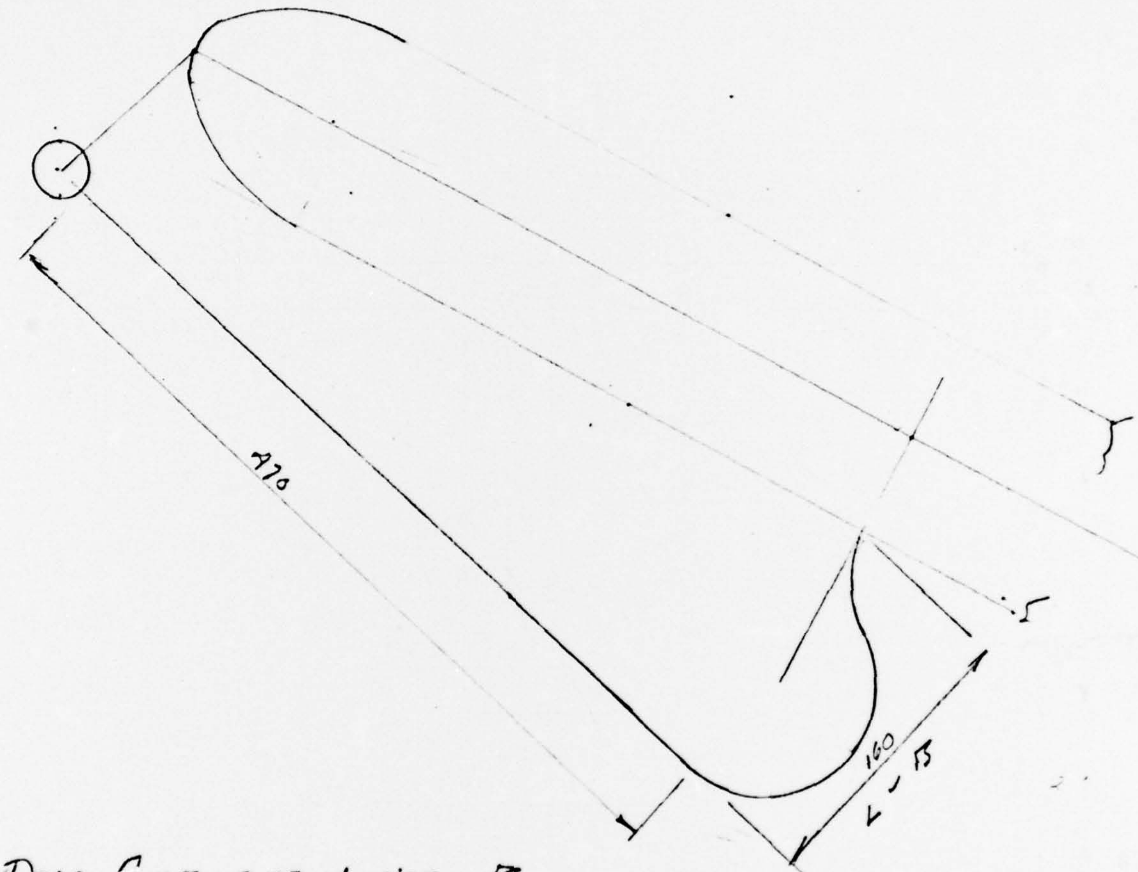
RAY McDERMOTT & CO., INC.

ENGINEERING DEPARTMENT - COMPUTATION SHEET — SHEET NO. ______

COMPANY ______

SUBJECT ______

DRAWING NO. ______ COMPUTER ______ CHKD. BY ______ DATE ______ 19 ______



DRAG COEF OVER LENGTH B

USE $C_D = 1.2$

TOTAL DRAG $= \frac{\rho}{2} V^2 \left(C_f S_1 + C_D \frac{A}{2}\right)$

$= 1 \times 45.6 \left(1.724 \times 10^{-5} \times 9 \times 470 + 1.2 \times \frac{2 \times 160}{2}\right)$ ½ LOAD

$= 45.6 (7.14 + 192$

$= 9130$ #

SAY 10 KIPS

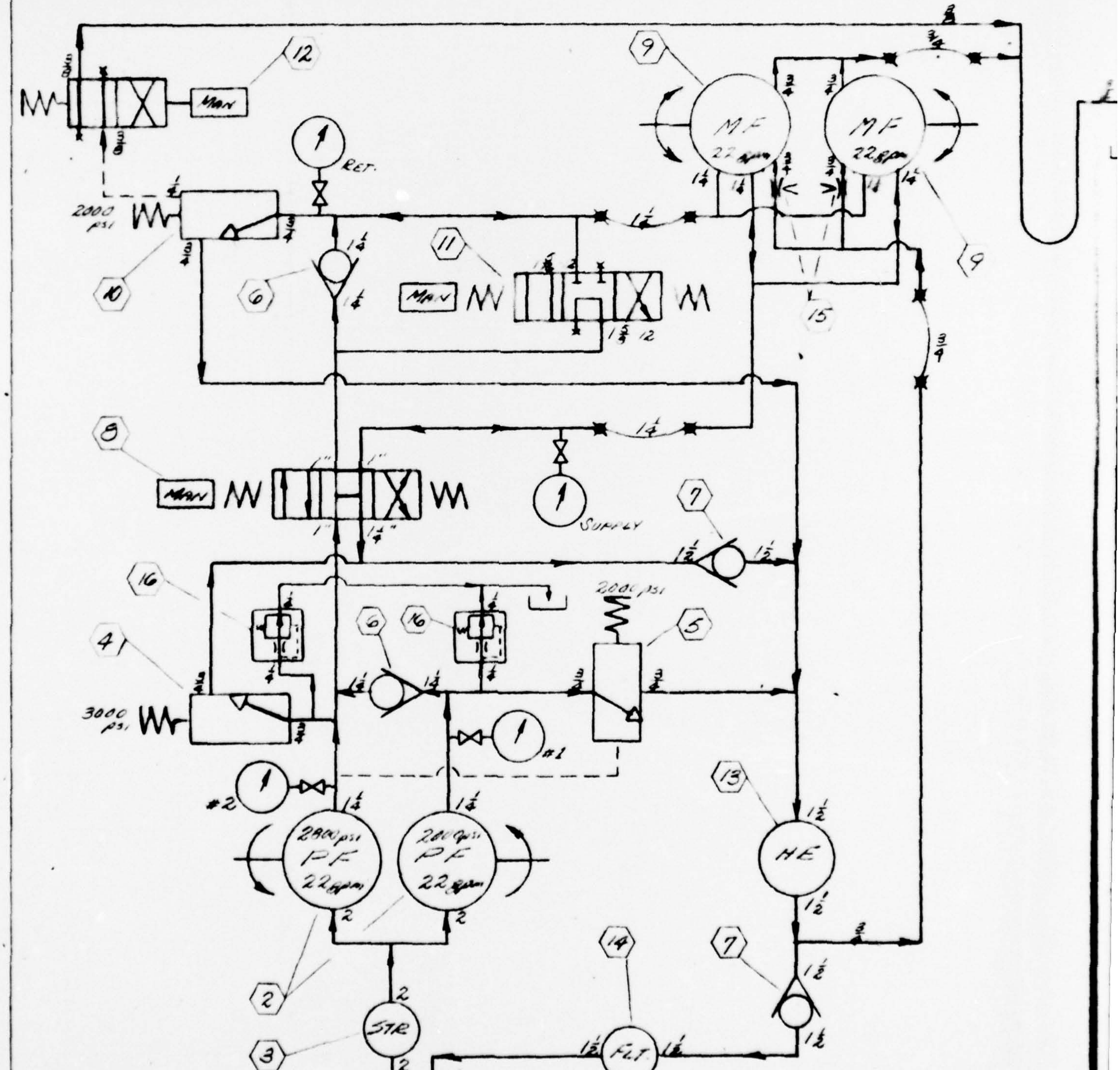
ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5036

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL
SHEET NO: 1 of 1

SUBJECT: CHAIN HANDLING BOOM - HYDRAULIC CIRCUIT

DRAWING NUMBER: J.O. 56017
COMPUTER: WAP
CHECKED BY:
DATE: 11/24/65



INSTALLATION EQUIPMENT

		VICKERS №.
(1)	RESERVOIR 88 GAL. NOM. CAP.	
(2)	PUMP - VANE TYPE - FIXED VOLUME	35V25A-1C10-132
(3)	STRAINER	50S-149-M-3-P4
(4)	RELIEF VALVE	CG-06-F-10
(5)	UNLOADING VALVE	RG-06-F4-10
(6)	CHECK	C2-825
(7)	CHECK	C2-830-S19
(8)	DIRECTIONAL VALVE	CM3N01-KBL-20
(9)	MOTOR (ROTO VERSAL 22000 SERIES BY GEARMATIC)	
(10)	RELIEF VALVE	CG-06-F-10
(11)	DIRECTIONAL VALVE	CM2N02-KDL-20
(12)	DIRECTIONAL VALVE	DG17S4-012A-41
(13)	OIL COOLER	OCA-30-10
(14)	FILTER	OFM-202
(15)	NEEDLE VALVE	
(16)	AIR BLEED VALVE	ABT-02-10

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5036

J. RAY McDERMOTT & CO., INC.

COMPANY U.S. ARMY - ERDL

SHEET NO. 1 of

SUBJECT MONO MOORING SYSTEM - ELECTRICAL SYSTEM CO

[redacted] NUMBER J.O. 56017

COMPUTER WAP

CHECKED BY

DATE ~~ON 8-20-65~~ REV 10-31-65

POWER LOAD ON ENG GENER

TOP SIDE:	RECEPTACLE	250 WATTS
	DK LIGHT (C.H. VPH4209)	200 "
		450 "
ENG COMPT.	VENTILATOR (2-FANS 190 W EA) (1-20L 37 W)	417 WATTS
	LIGHTING (2 R&S 6250MC 75 W EA)	150 "
		567 "
STORES COMPT.	VENTILATOR (1-5... 37 W)	37 WATTS
	LIGHTING (2 - R&S 6250MC 50 W EA)	100 "
		137 "
		1154 WATT

REQD MIN. GEN CAP. 24V D.C. SYSTEM

$I = \frac{P}{E} = \frac{1154}{24} = 48$

RESERVE CAP 1

$48.1 \times 1.15 = 5$

ENG. EQUIPPED W/ 24V, 60 AMP

1

LOAD

65

65

ENERATOR

TTS

ATTS

"

IATTS

"

"

WATTS TOTAL

TEM

48.1 AMPS

15

55.3 AMP CAP MIN.

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5036

J. RAY MCDERMOTT & CO., INC.

COMPANY	SHEET NO.
U.S. ARMY - ERDL	1 of

SUBJECT: MONO MOORING SYSTEM - ELECTRICAL SYSTEM

NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAD		6-10-65

POWER LOAD ON ENG GENERATOR

TOP SIDE:	FLOODLIGHT	250	WATTS
	DECK LIGHTING (6-75w)	450	"
		700	"
ENG. COMPT:	VENT FAN	100	WATTS
	LIGHTING (3-75w)	225	"
		325	
STORAGE COMPT:	VENT FAN	100	WATTS
	LIGHTING (2-75w)	150	
		250	
	TOTAL	1275	WATT

REQD GEN CAP.: 24 VOLT SYSTEM - D.C.

$I = \frac{P}{E} = \frac{1275}{24} = 53.1$ AMPS LOA[D]

RESERVE CAPACITY 15%

$53.1 \times 1.15 = 61$ AMP GEN REQD

ENG EQUIPPED w/ 60 AMP 24 VOLT [illegible]

1

see revised sheet 8/20/65

e

s LCM

n LGO

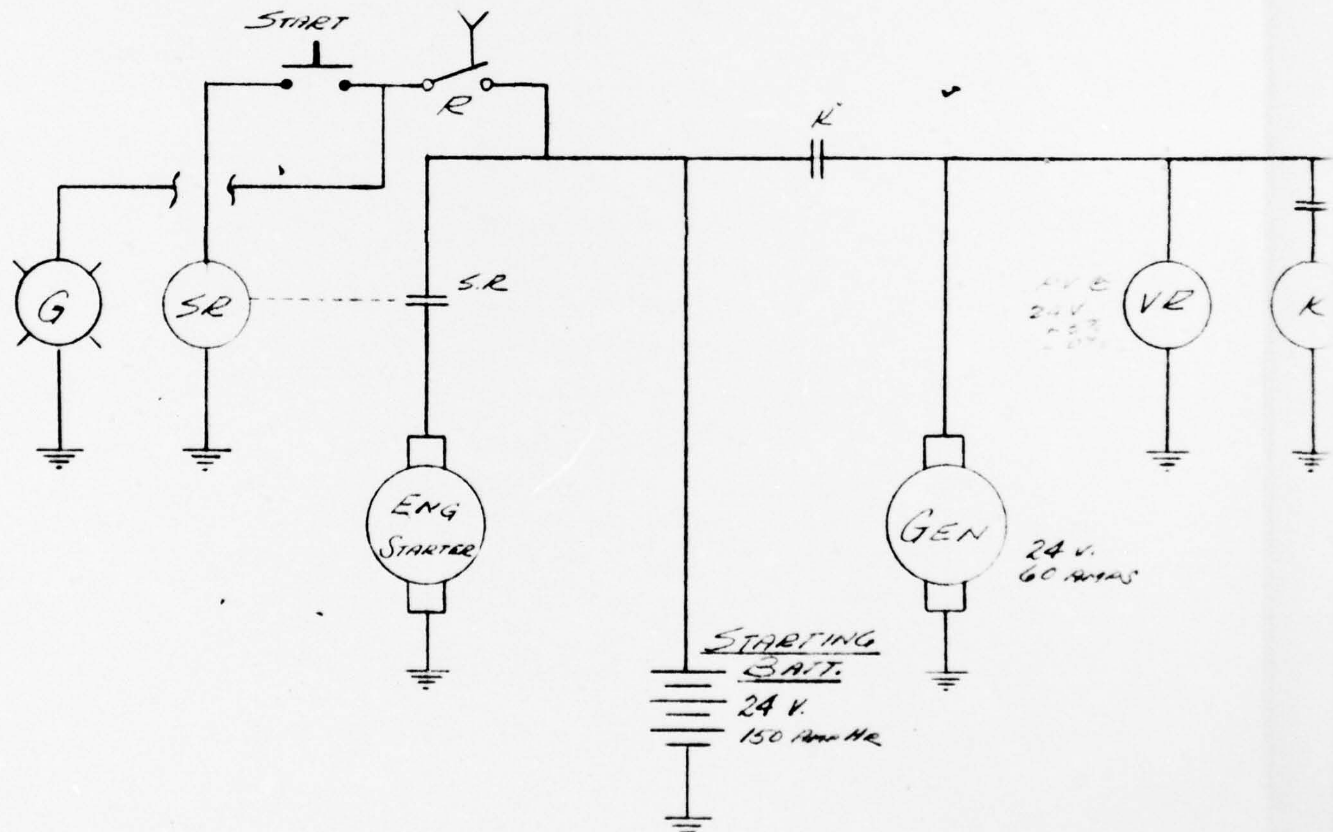
ALTERNATOR

2

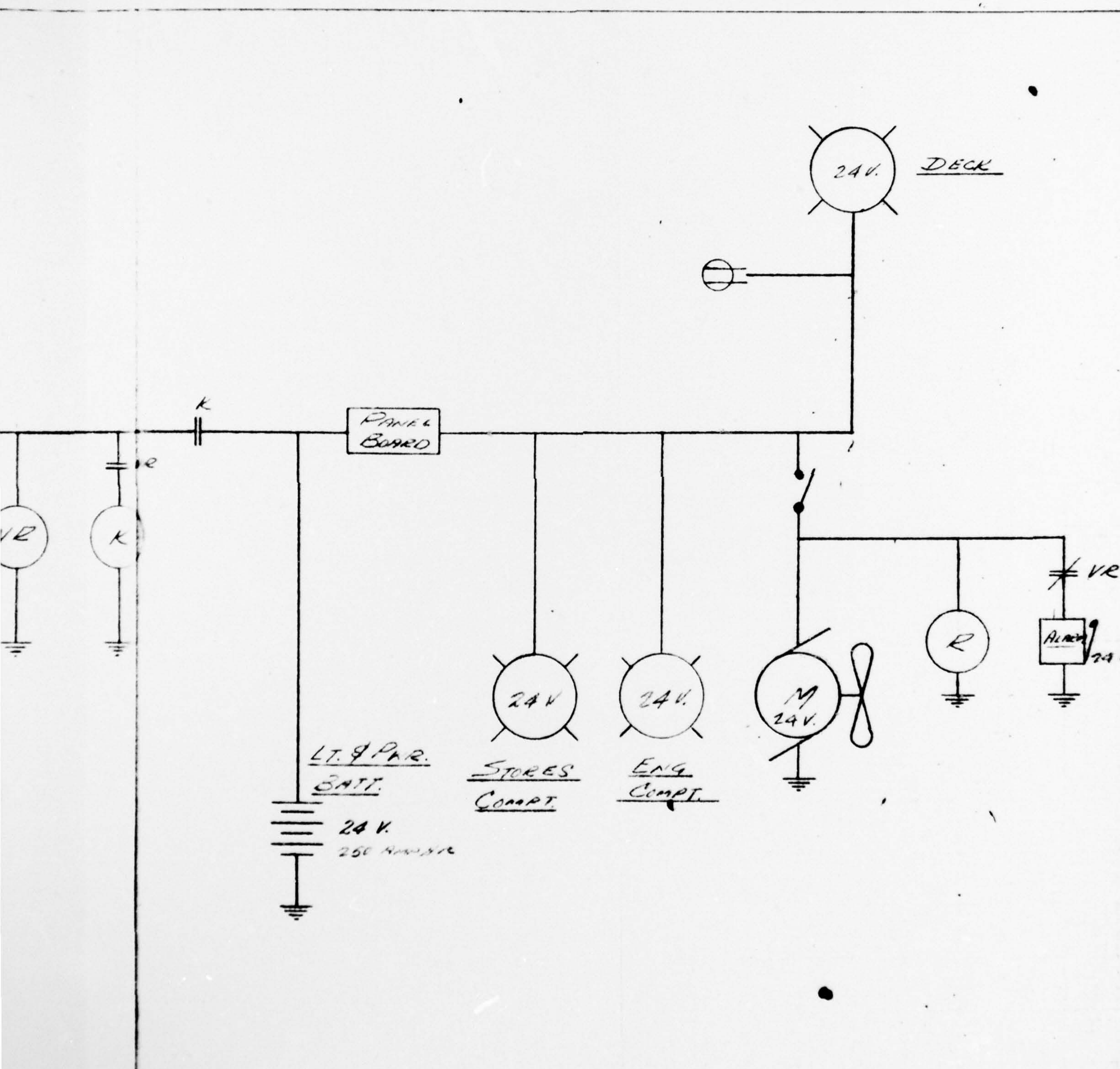
ENGINEERING DEPARTMENT COMPUTATION SHEET
McD 5036

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL
SHEET NO: 2 of
SUBJECT: MONO MOORING SYSTEM - ELECTRICAL SYSTE[M]
DRAWING NUMBER:
COMPUTER:
CHECKED BY:
DATE:



...r
...c System



24V.
DECK
K
PANEL BOARD
R
VR
K
VR
R
ALARM
24 V.
M
24V.
24 V
24 V.
LT. & PWR. BATT.
24 V.
STORES COMPT.
ENG COMPT.

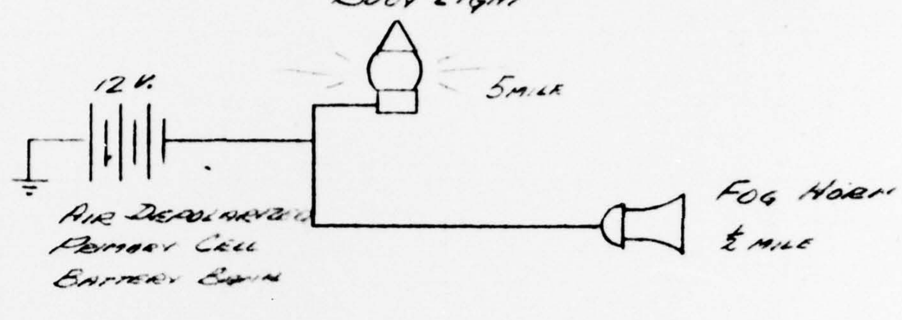
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5036

J. RAY McDERMOTT & CO., INC.

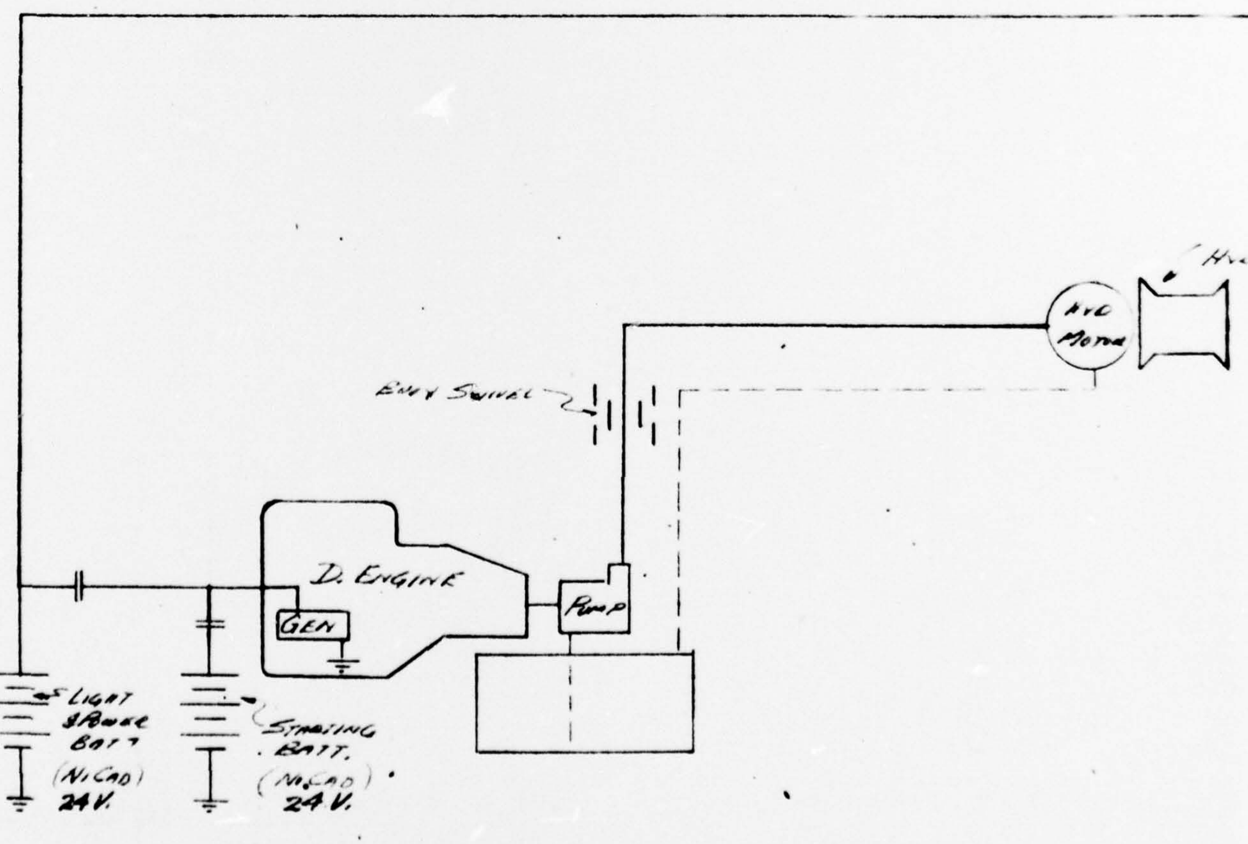
COMPANY	SHEET NO
U.S. ARMY - ERDL	10 of 1

SUBJECT: MONO MOORING SYSTEM - EQUIPMENT

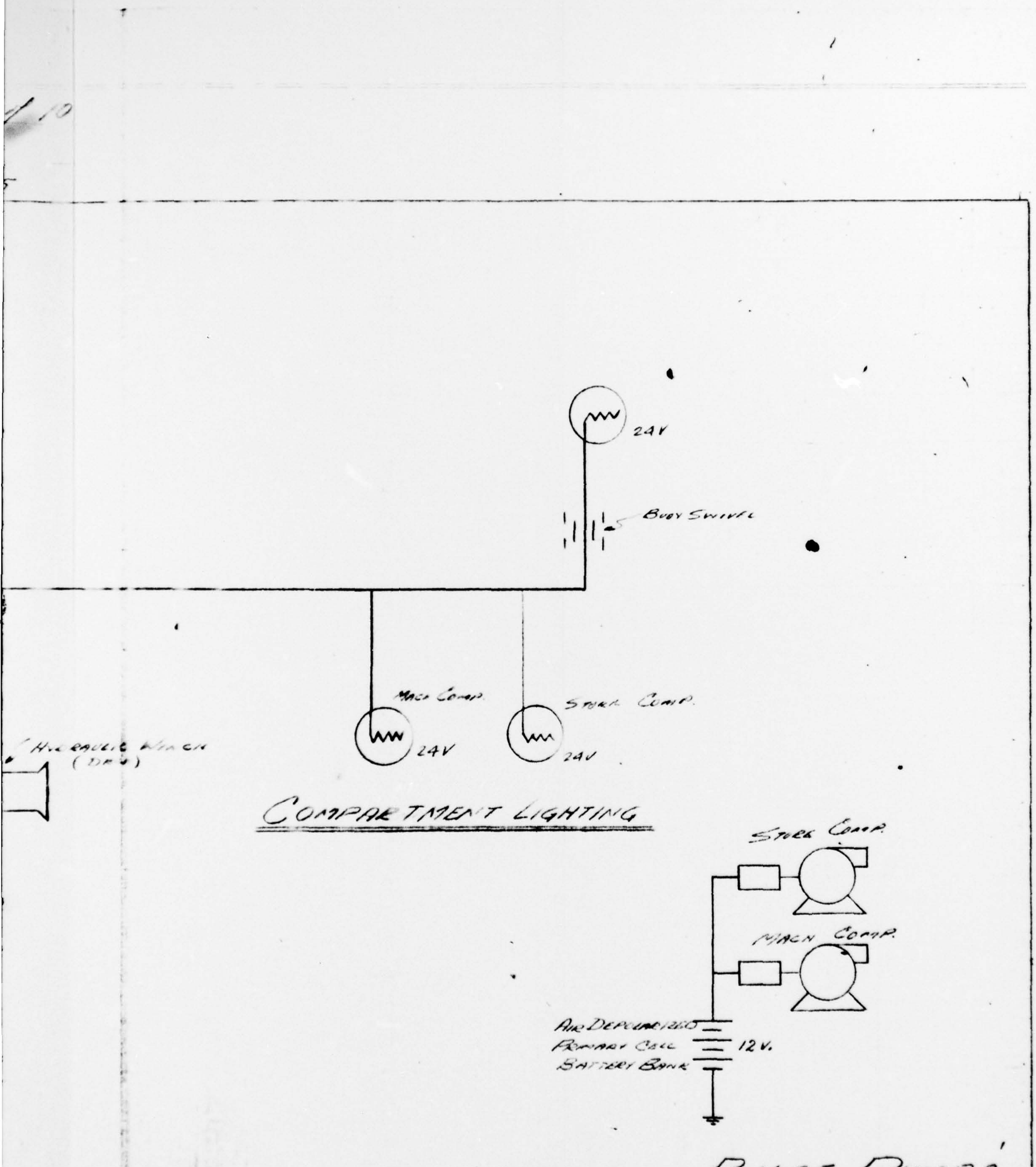
NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAP		6-17-65



NAVIGATIONAL AIDS



HYD. PUMPING UNIT


24V
BODY SWIVEL
MACH COMP.
STBD COMP.
24V
24V
HYDRAULIC WINCH
COMPARTMENT LIGHTING
STBD COMP.
MACH COMP.
AIR DEPOLARIZED
PRIMARY CELL
BATTERY BANK
12V.
BILGE PUMPS

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

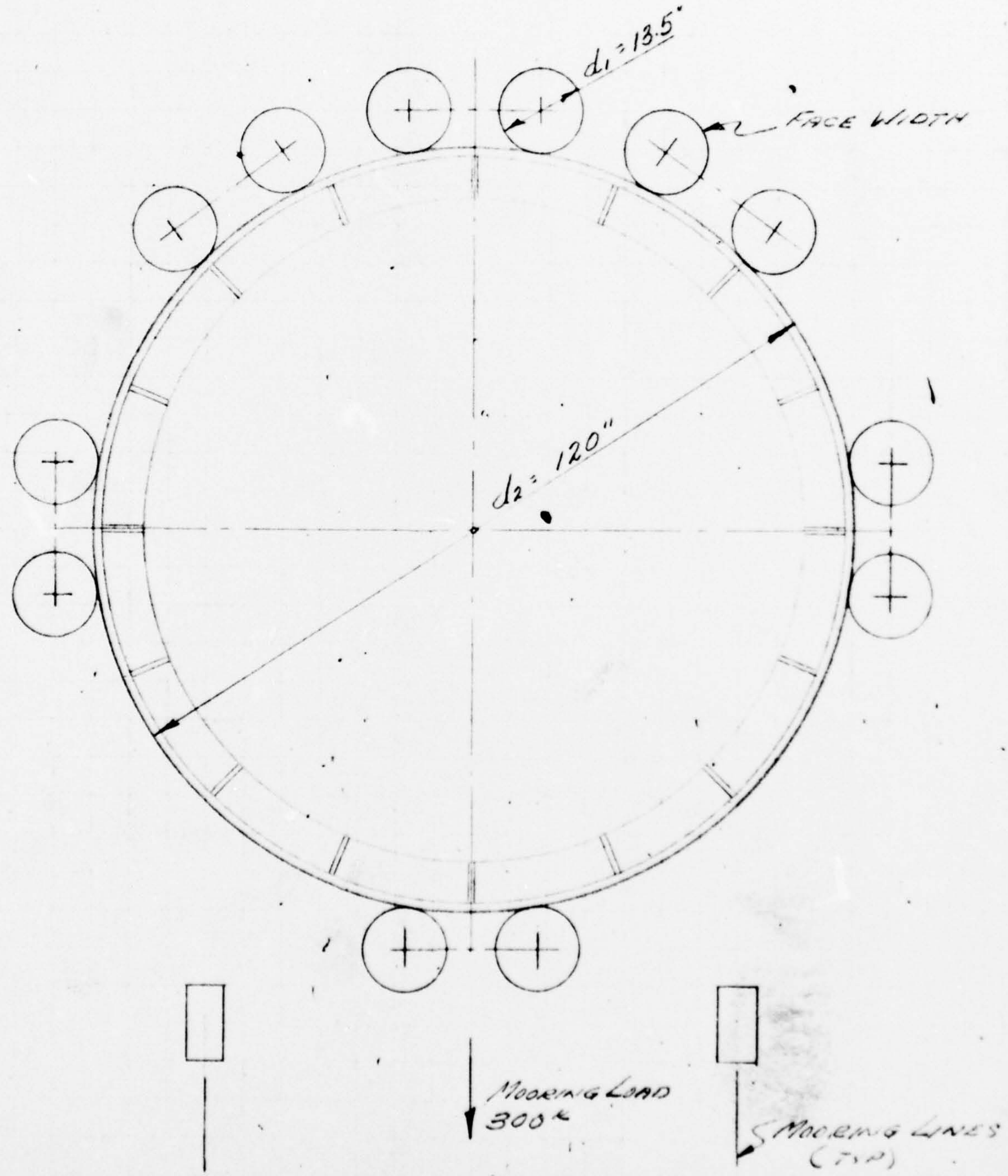
J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY - ERDL	1 of 6

SUBJECT
MONO MOORING SYSTEM - INNER RACE BOGIE

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JO 56017	WAP		4/13/65

INNER RACE · FOR HORIZONTAL LOA[D]



BOGIE CALCULATIONS

LOAD

PRESSURES & AREAS of CONTACT / BOGIE

MOORING LOAD = 300^k MAX

ACTIVE BOGIES = 6

LOAD / BOGIE = $\frac{300}{6} = 50^k$ +

formulas: —

LOAD CAPACITY PER LIN. INCH of WHEEL FACE (AISC) pp 5-19

$$F_p = \left(\frac{F_y - 13{,}000}{20{,}000}\right) 660\, d = \text{LBS}$$

AREAS of CONTACT & PRESSURES (KENT 8-36)

$$S_c = .591 \sqrt{F_p E \left(\frac{d_1 + d_2}{d_1 \times d_2}\right)}$$

$$b = 2.15 \sqrt{\frac{F_p}{E} \left(\frac{d_1 \times d_2}{d_1 + d_2}\right)}$$

$$y = \frac{2(1-V^2)}{E} \frac{F_p}{\pi} \left(\frac{2}{3} + \log_e \frac{2d_1}{b} + \log_e \frac{2d_2}{b}\right)$$

F_y = YIELD STRENGTH of STEEL = 42,000 psi

F_p = WHEEL CAPACITY PER LIN. IN. = LBS

S_c = MAX PRESSURE AT ℄ CONTACT = psi

E = MODULUS of ELASTICITY = 30,000,000

b = CONTACT WIDTH = INCHES

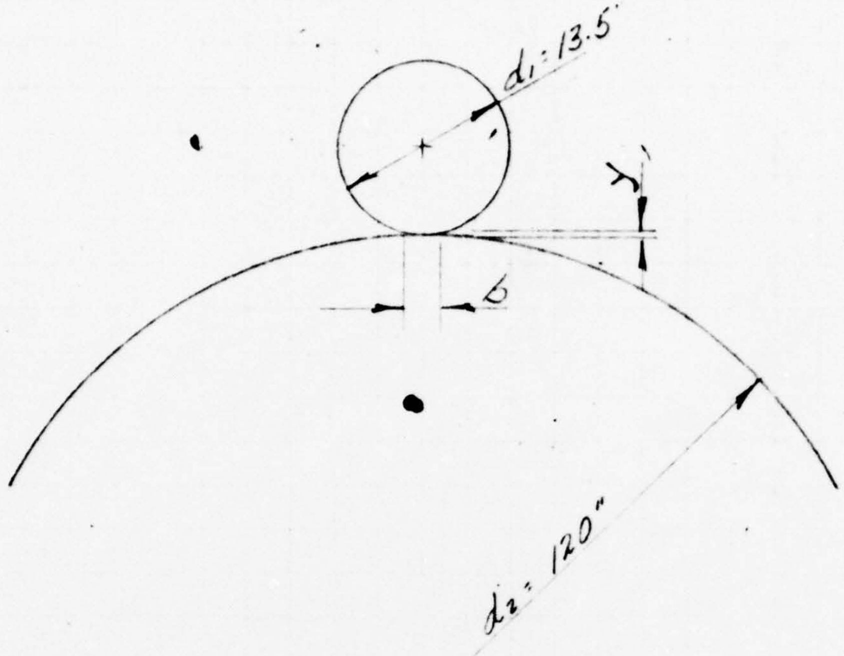
y = COMBINED DEFORMATION of BOTH BODIES = IN.

V = POISSION'S RATIO = .3

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14-03

J. RAY MCDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL	SHEET NO. 2 of 6
SUBJECT: MONO MOORING SYSTEM - INNER RACE BOGIE	
NUMBER: J.O. 56017 · COMPUTER: WAD · CHECKED BY:	DATE: 4/13/65



ALLOWABLE LOAD / INCH OF FACE WIDTH OF WHEEL

$$F_P = \left(\frac{F_y - 13000}{20{,}000}\right) 660 d_1$$

$$F_P = \left(\frac{42 - 13}{20}\right) 660 \times 13.5 = 12{,}900 \text{ LBS/LIN. IN.}$$

FACE WIDTH OF WHEEL

$$W = \frac{\text{LOAD}}{F_P}$$

$$W = \frac{50^k}{12.9} = 3.87" \quad \text{USE } \underline{4}" \text{ MIN.}$$

BASIC CALCULATIONS

ACTUAL F_P $= \frac{LOAD}{W}$

$$F_P = \frac{50^k}{4} = \underline{\underline{12.5^k}}$$

MAX UNIT STRESS AT CONTACT POINT

$$S_c = .591 \sqrt{F_P E \left(\frac{d_1 + d_2}{d_1 \times d_2}\right)}$$

$$S_c = .591 \sqrt{12{,}500 \times 30 \times 10^6 \left(\frac{13.5 + 120}{13.5 \times 120}\right)}$$

$$S_c = .591 \sqrt{375 \times 10^9 \; (.0825)} \quad = \underline{\underline{103{,}500 \text{ PSI}}}$$

CONTACT WIDTH

$$b = 2.15 \sqrt{\frac{F_P}{E} \left(\frac{d_1 \times d_2}{d_1 + d_2}\right)}$$

$$b = 2.15 \sqrt{\frac{12{,}500}{30 \times 10^6} \left(\frac{13.5 \times 120}{13.5 + 120}\right)}$$

$$b = 2.15 \sqrt{.000416 \; (12.1)} \quad = \quad \underline{\underline{0.153''}}$$

TOTAL DEFORMATION OF BOTH BODIES

$$y = \frac{2(1 - V^2)}{E} \frac{F_P}{\pi} \left(\frac{2}{3} + \log_e \frac{2 d_1}{b} + \log_e \frac{2 d_2}{b}\right)$$

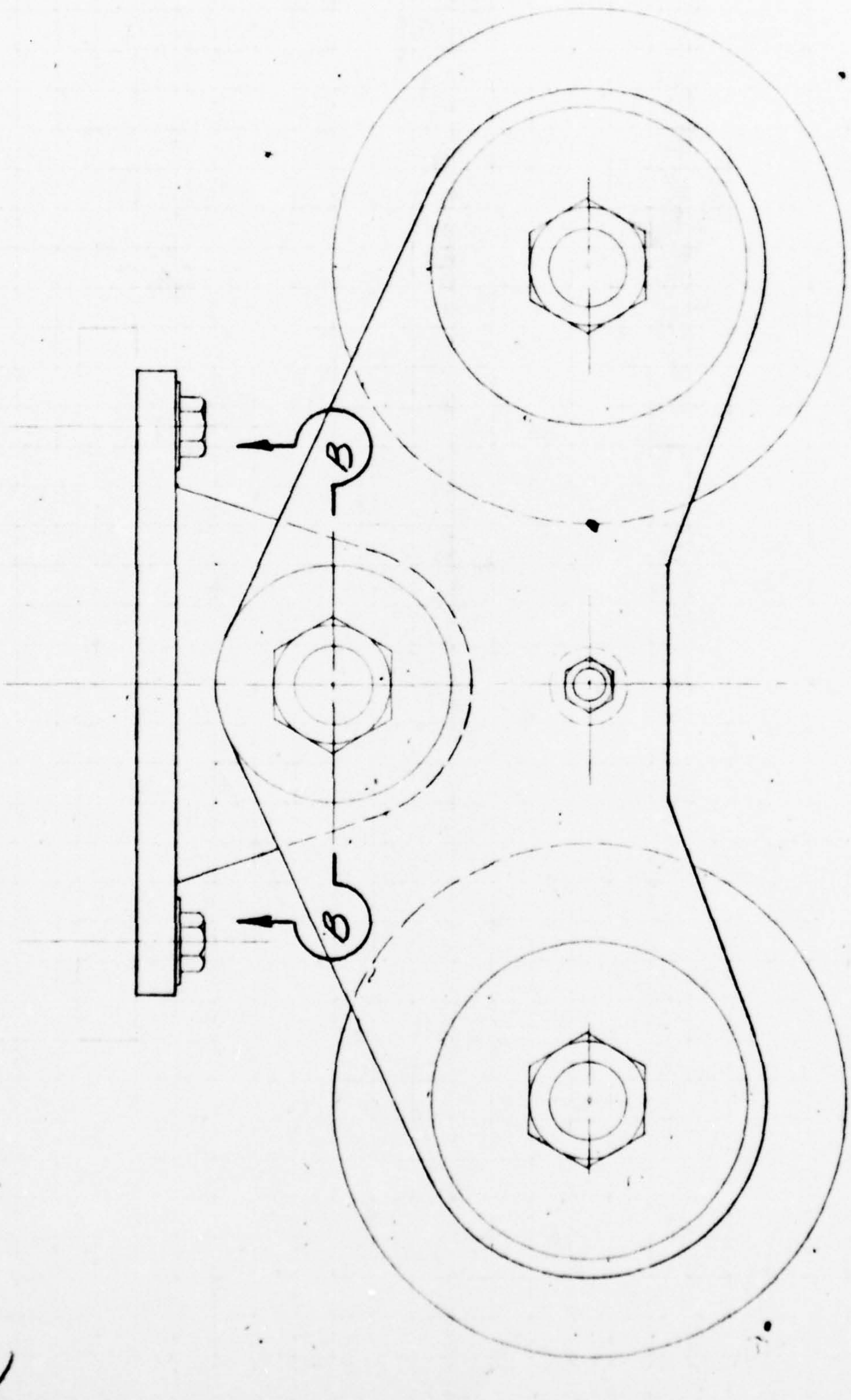
$$y = \frac{2(1 - .3^2)}{30 \times 10^6} \times \frac{12{,}500}{3.14} \left(\frac{2}{3} + \log_e \frac{2 \times 13.5}{.153} + \log_e \frac{2 \times 120}{.153}\right)$$

$$y = .00000006 \times 4160 \; (13.7) \quad = \quad \underline{\underline{0.0034''}}$$

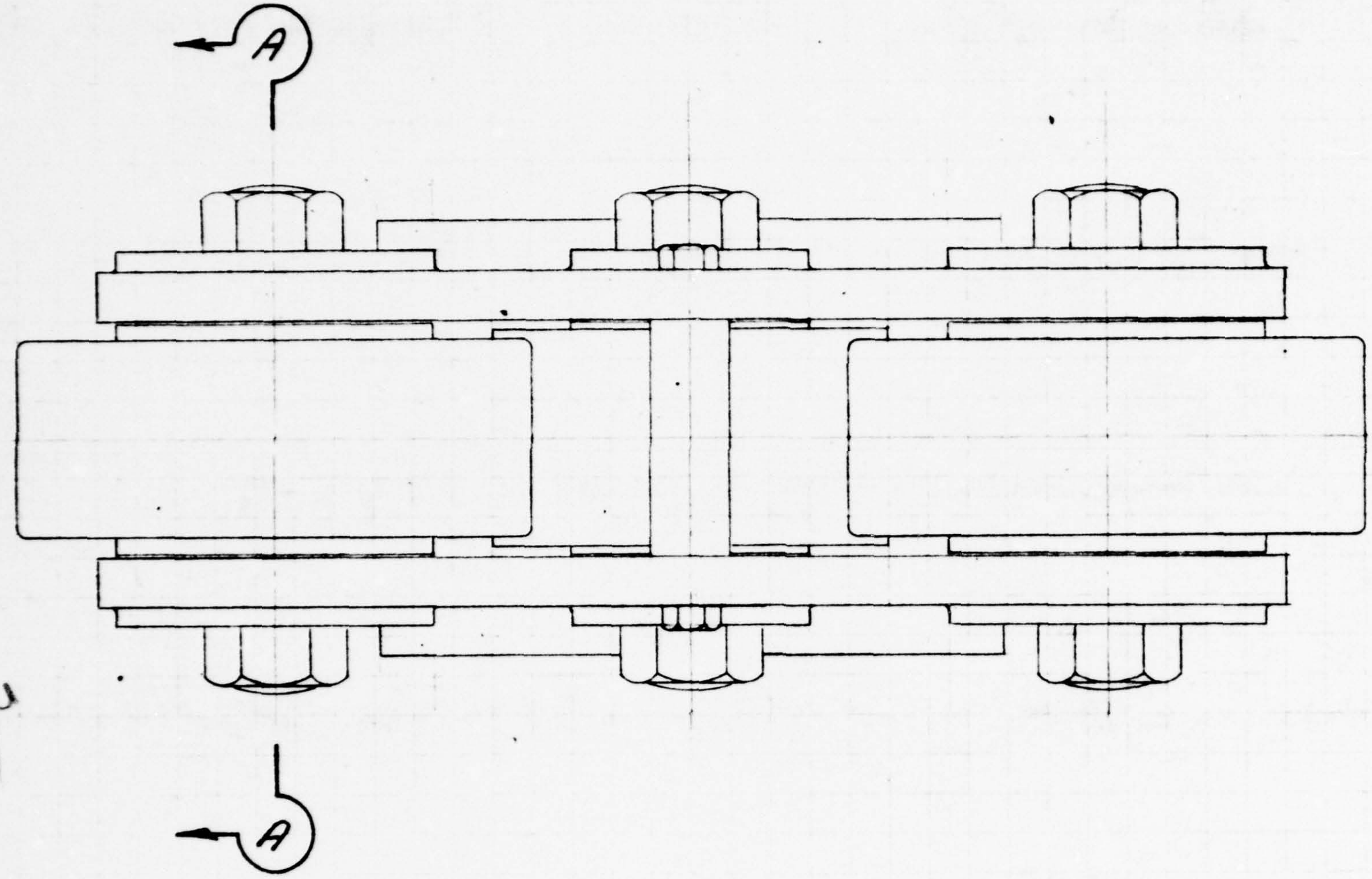
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY - ERDL	SHEET NO: 3 of 6
SUBJECT: MONO MOORING SYSTEM - INNER RACE BOGIE	
NUMBER: J.O. 56017	COMPUTER: WRP
CHECKED BY:	DATE: 4/13/65



PLAN

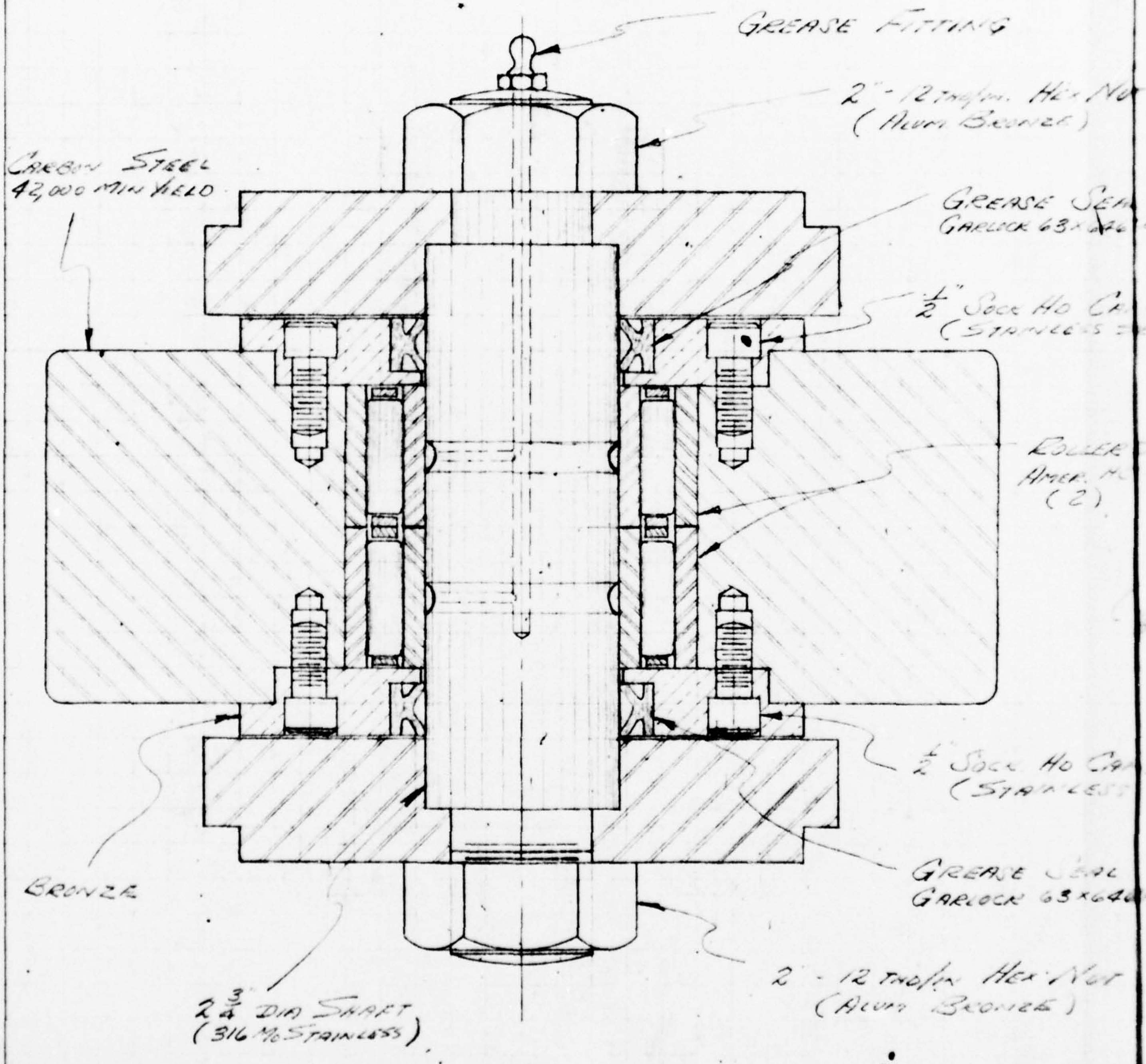


ELEVATION

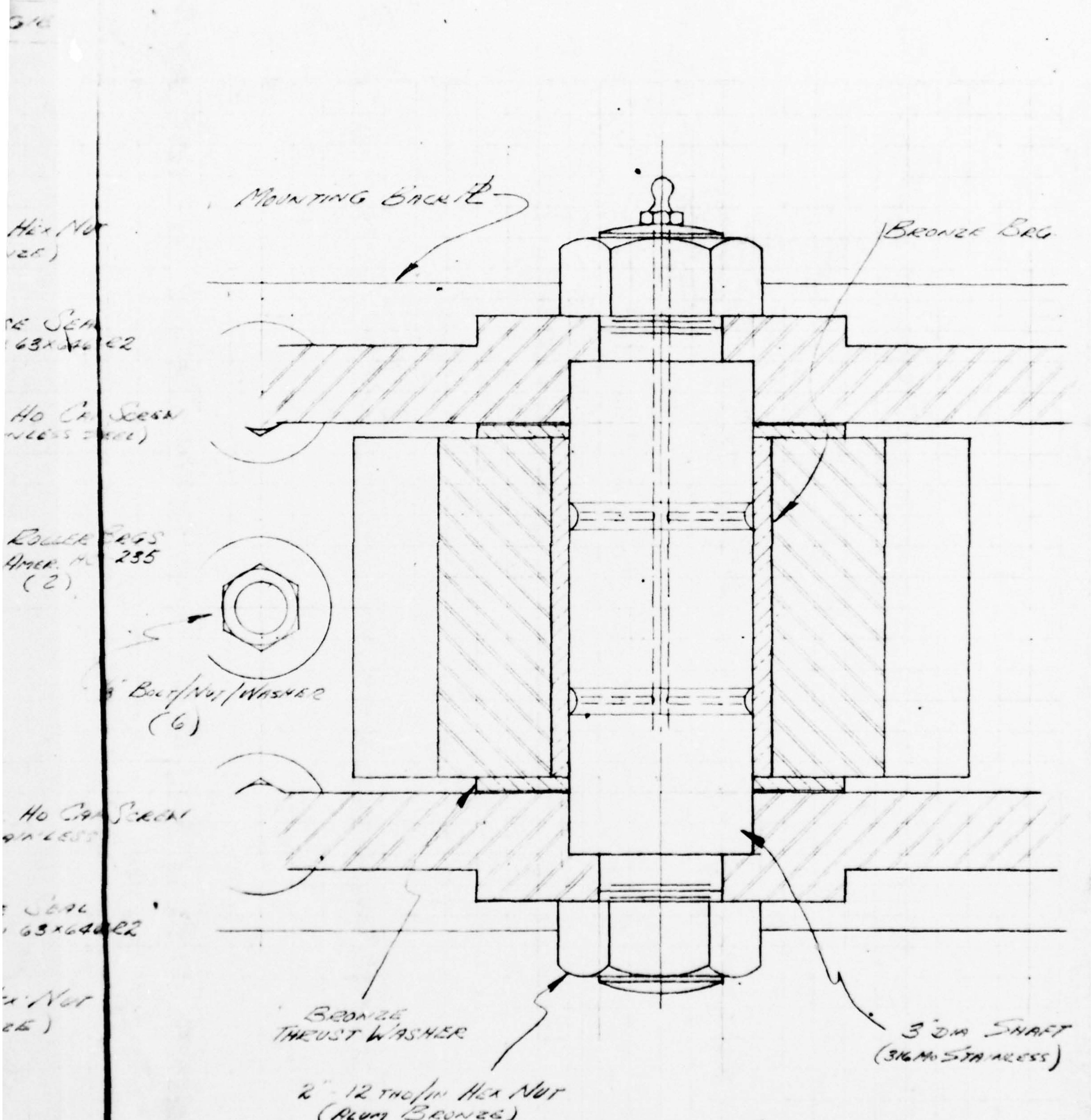
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY U.S. ARMY - E.R.D.L.			SHEET NO. 4 of 6
SUBJECT MONO MOORING SYSTEM - INNER RACE BOG[illegible]			
[redacted] NUMBER J.O 56017	COMPUTER WAD	CHECKED BY	DATE 4/12/65



SECTION "A-A"



MOUNTING BACKET
BRONZE BRG
BRONZE
THRUST WASHER
2" - 12 THD/IN HEX NUT
(ALUM BRONZE)
3" DIA SHAFT
(316 MO STAINLESS)
HEX NUT
SEAL
63X646E2
HD CAP SCREW
ROLLER BRGS
(2)
BOLT/NUT/WASHER
(6)
HD CAP SCREW
SEAL
63X646R2
HEX NUT

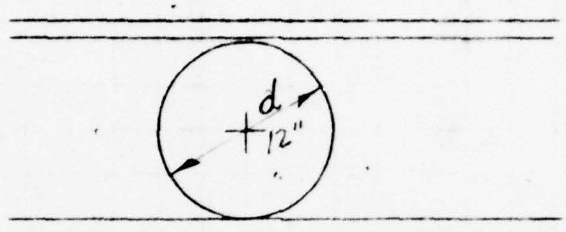
SECTION "B-B"

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 1A003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL			SHEET NO: 5 of 6
SUBJECT: MONO MOORING SYSTEM - OUTER RACE BOGIE C			
NUMBER: J.O. 56017	COMPUTER: WAD	CHECKED BY:	DATE: 4/14/65

OUTER RACE FOR VERTICAL LOA



PRESSURES & AREAS OF CONTACT / BOGIE

MOORING LOAD = 195^k
ACTIVE BOGIES = 6
LOAD / BOGIE = $\frac{195}{6} = 32.5^k$
FACE WIDTH = 4"

formulas: -

LOAD CAPACITY PER LIN. INCH OF WHEEL FACE

$$F_p = \left(\frac{F_y - 13{,}000}{20{,}000}\right) 660\, d = \left(\frac{42 - 13}{20}\right) 660 \times 12 = 11{,}500$$

AREAS OF CONTACT & PRESSURES

$$S_c = .591 \sqrt{\frac{F_p E}{d}}$$

$$b = 2.15 \sqrt{\frac{F_p d}{E}}$$

BOGIE CALCULATIONS

LOAD

ACTUAL $F_p = \frac{LOAD}{W}$

$F_p = \frac{32.5}{4} = \underline{8.125^K}$

MAX UNIT STRESS AT CONTACT POINT

$S_c = .591 \sqrt{\frac{F_p E}{d}}$

$S_c = .591 \sqrt{\frac{8.125 \times 30 \times 10^6}{12}}$

$S_c = .591 \sqrt{20,300,000,000} = \underline{\underline{84,000 \text{ psi}}}$

CONTACT WIDTH

$b = 2.15 \sqrt{\frac{F_p d}{E}}$

$b = 2.15 \sqrt{\frac{8125 \times 12}{30 \times 10^6}}$

$b = 2.15 \sqrt{.00325} = \underline{\underline{0.122''}}$

COMPRESSION OF WHEEL BETWEEN TWO PLATES

$\Delta D = 4 F_p \left(\frac{1 - \nu^2}{\pi E}\right)\left(\frac{1}{3} + \log_e \frac{2d}{b}\right)$

$\Delta D = 4 \times 8125 \left(\frac{1 - .3^2}{3.14 \times 30 \times 10^6}\right)\left(\frac{1}{3} + \log_e \frac{2 \times 12}{.122}\right)$

$\Delta D = 32.5\ (.00000000965)\ (5.47)$

$\Delta D = \underline{\underline{0.0000016''}}$

E

= 11,500

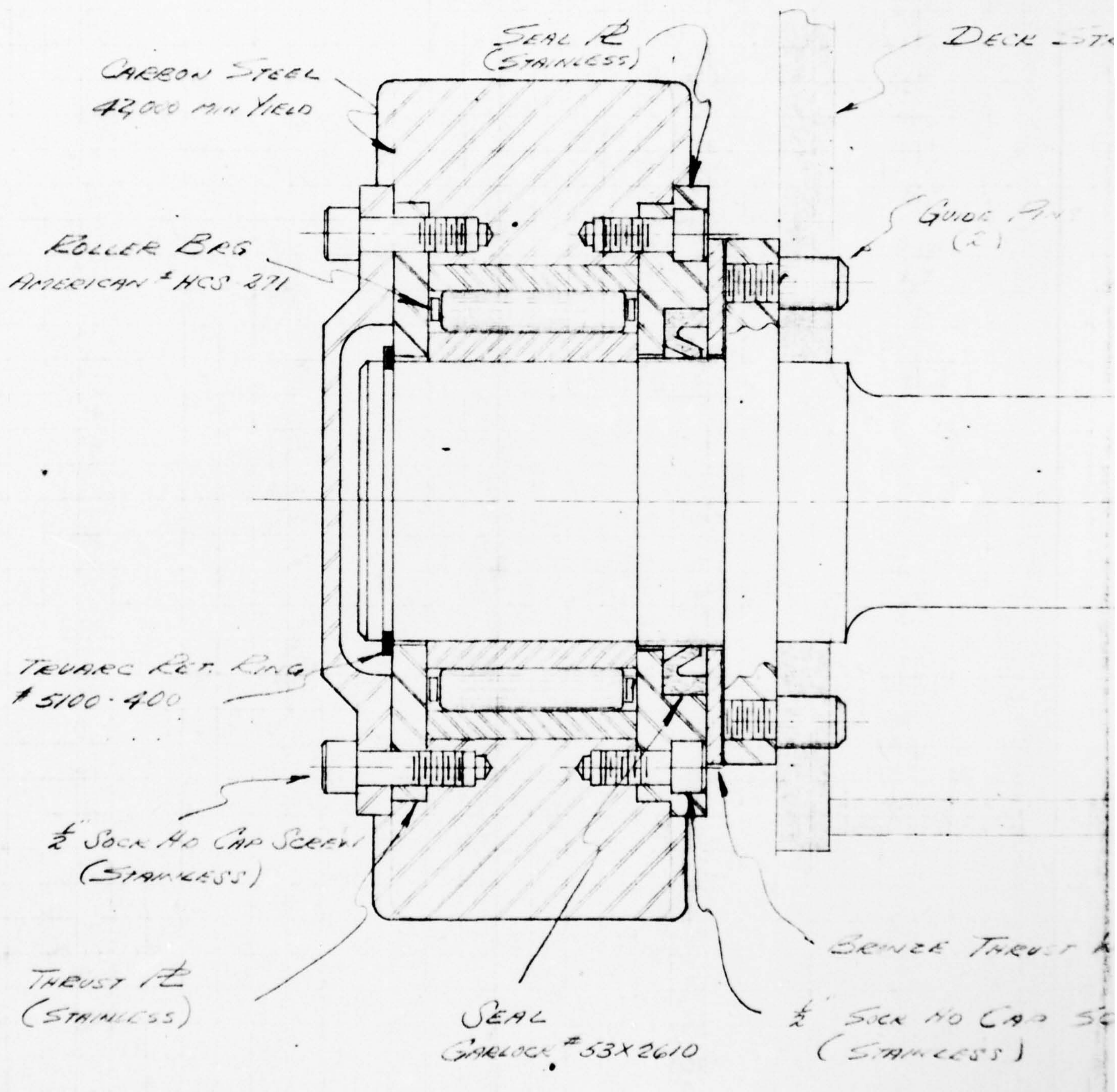
2

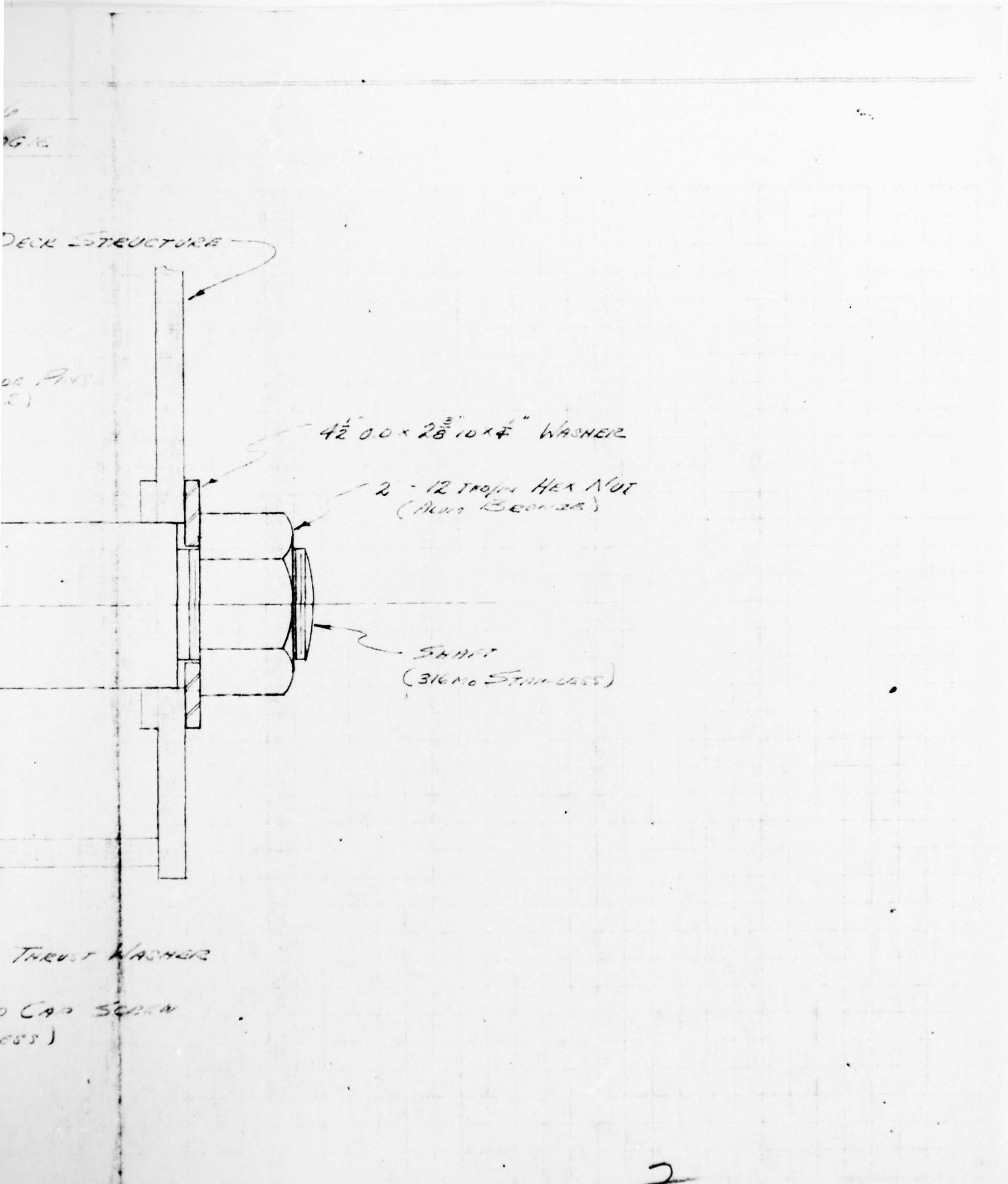
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY - ERDL	6 of 6
SUBJECT	
MONO MOORING SYSTEM - OUTER RACE BOGIE	

~~DRAWING~~ NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAD		4/13/65



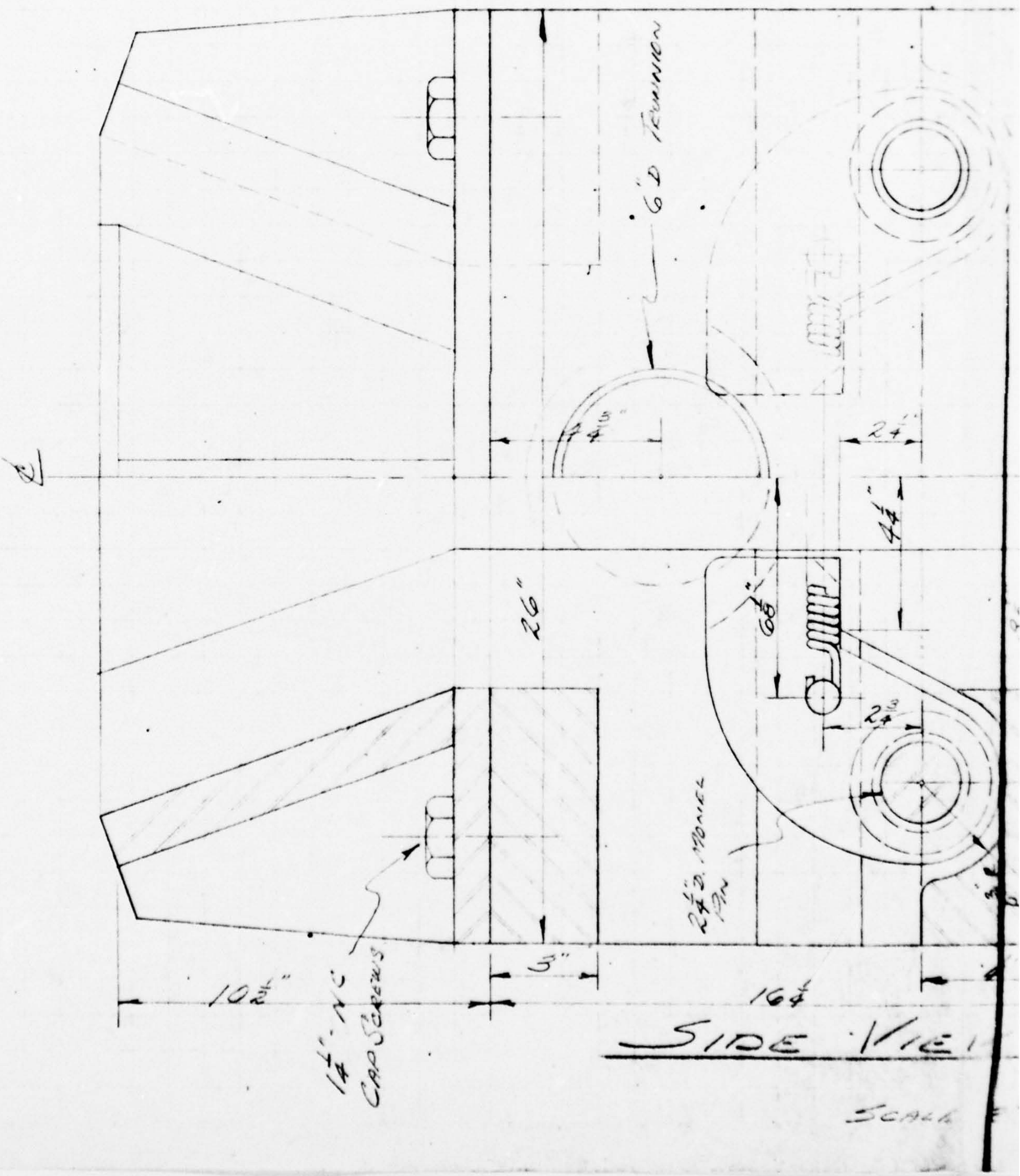

DECK STRUCTURE
4½" O.D × 2⅜" I.D × ¼" WASHER
2 - 12 THD/IN HEX NUT
(ALUM BRONZE)
SHAFT
(316 Mo STAINLESS)
THRUST WASHER
CAP SCREW

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

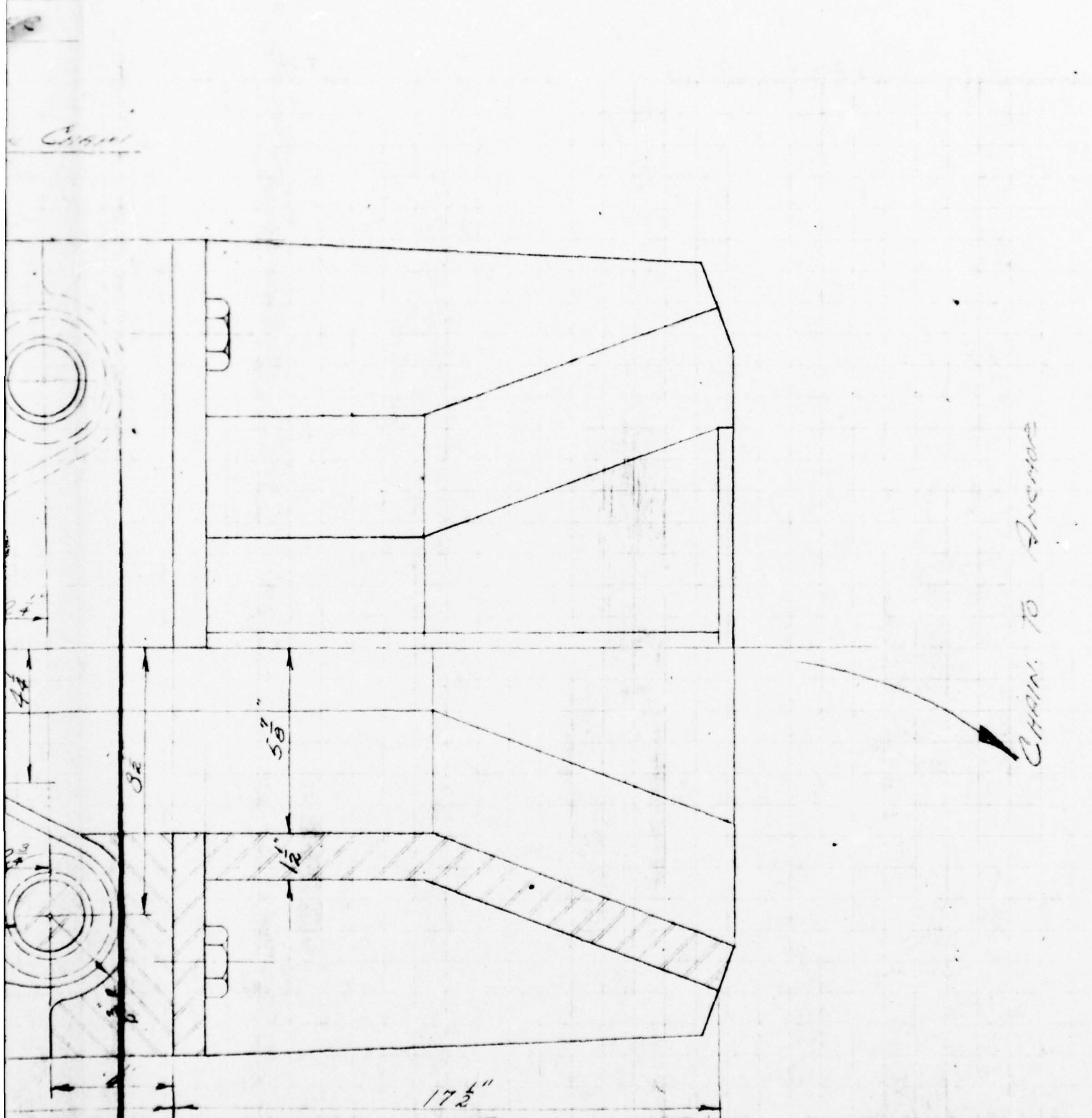
COMPANY: U S ARMY - ERDL	SHEET NO: 1 of 4
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER	
DRAWING NUMBER: JO. 56017	COMPUTER: WA · CHECKED BY: · DATE: 5-11-65

DESIGNED for STD. 3" WELDED STUD LINK CHAIN



SIDE VIEW

SCALE



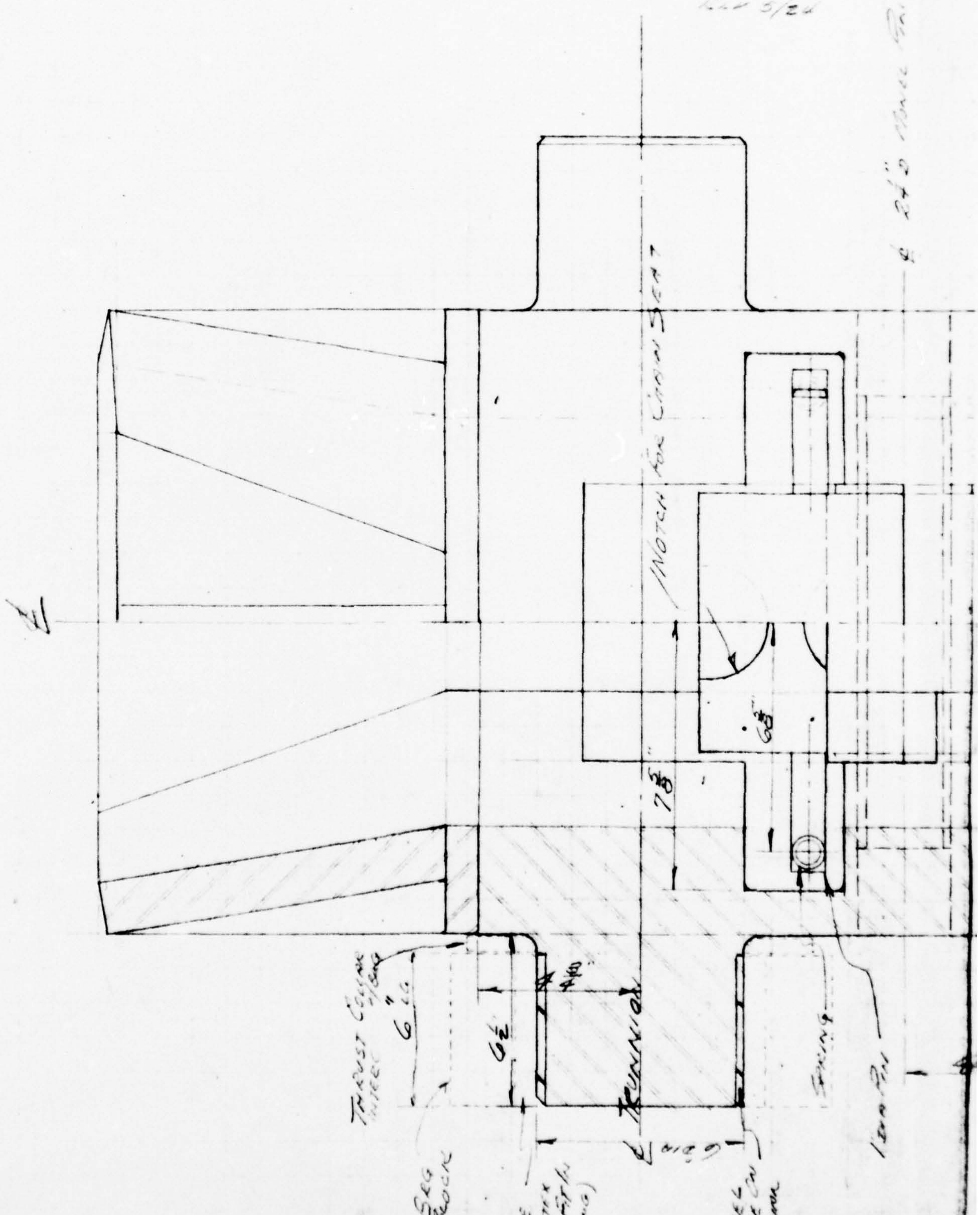
VIEW - QUARTER SECTIONED

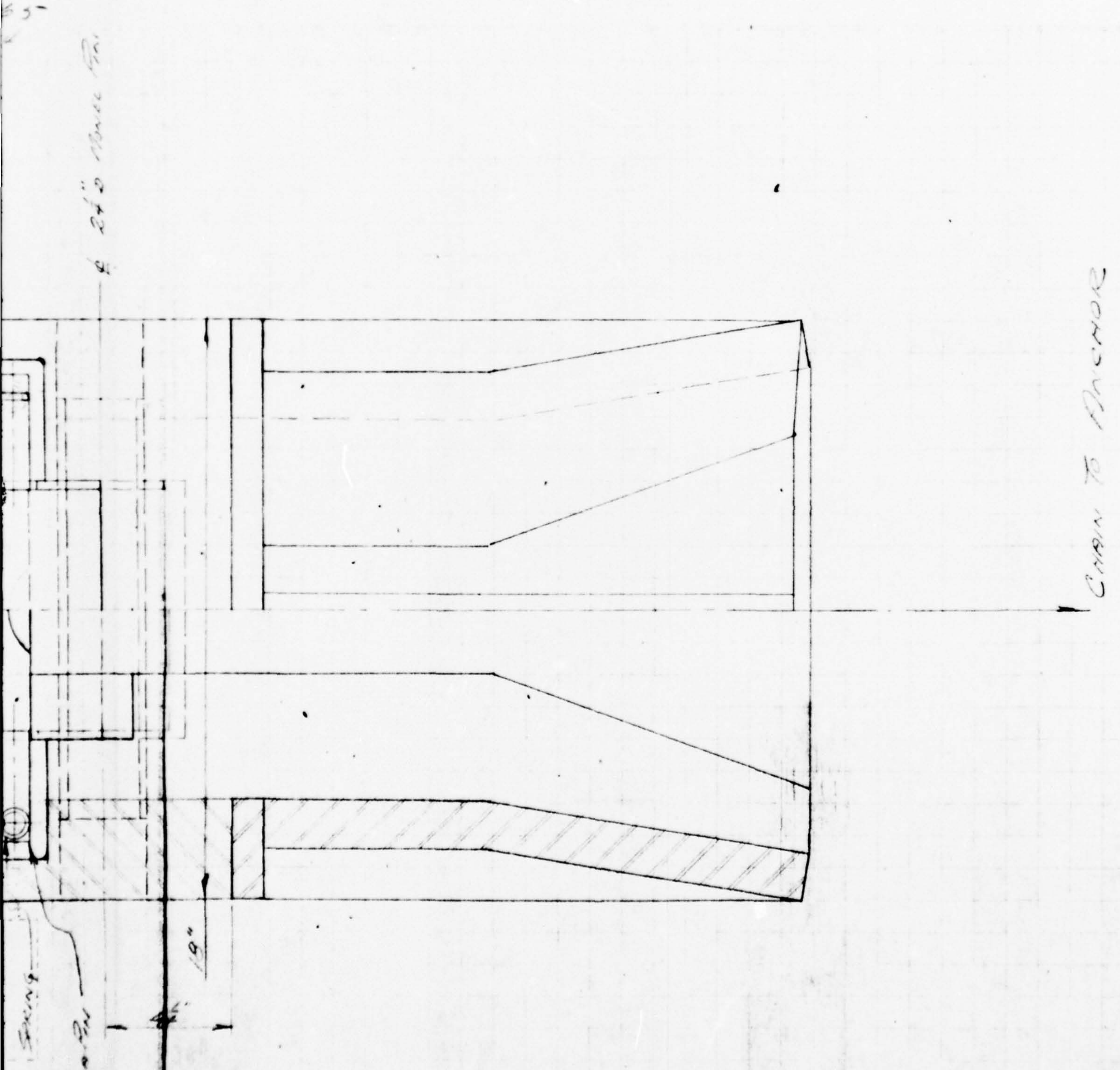
SCALE

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL	SHEET NO: 2 of 4
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER	
NUMBER: J.O. 56017	COMPUTER: [illegible]
CHECKED BY:	DATE: 5-11-65 Rev 5/24





FRONT VIEW - QUARTER SECT.

SCALE 3" = 1'-0"

2

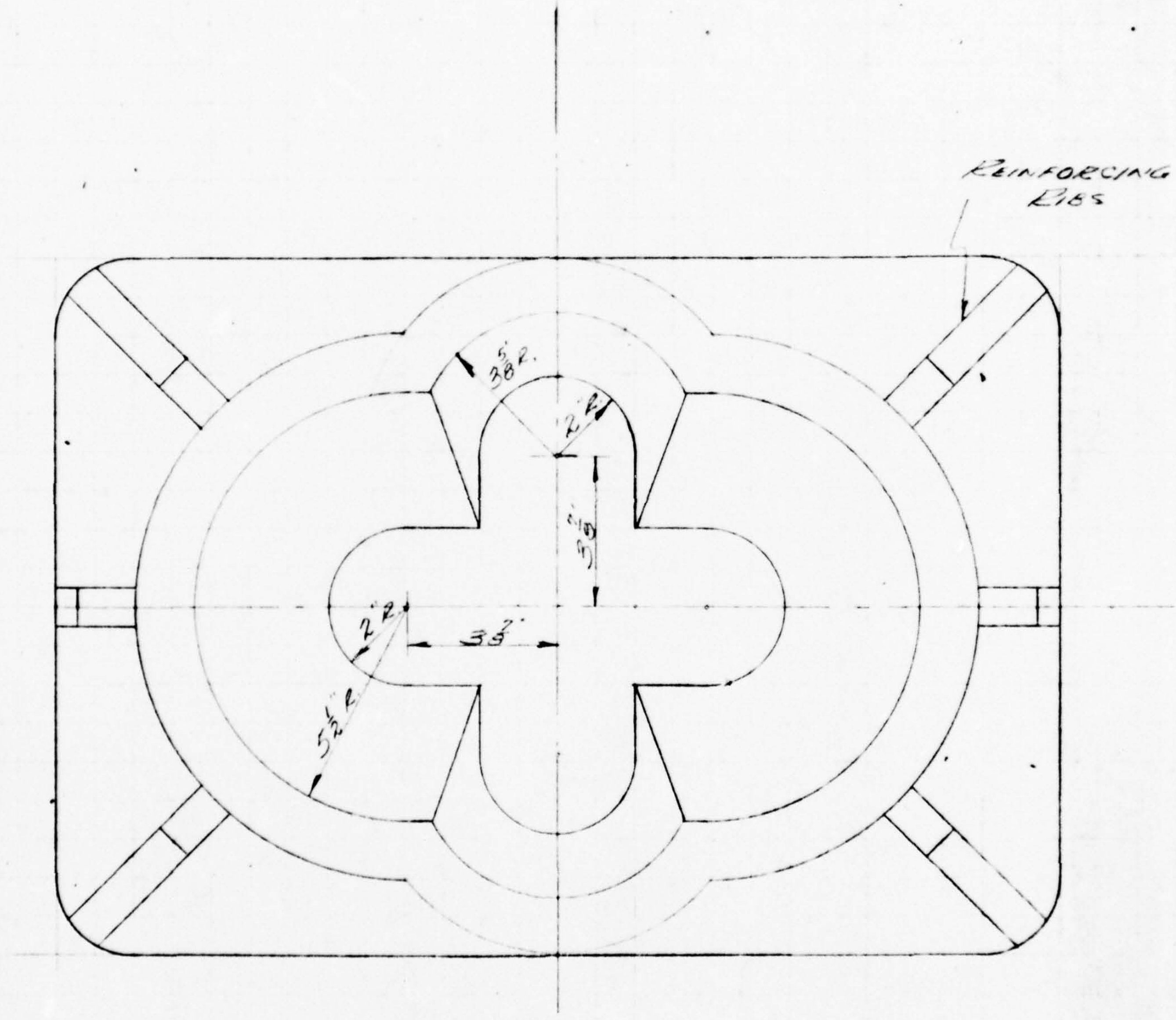
ENGINEERING DEPARTMENT COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

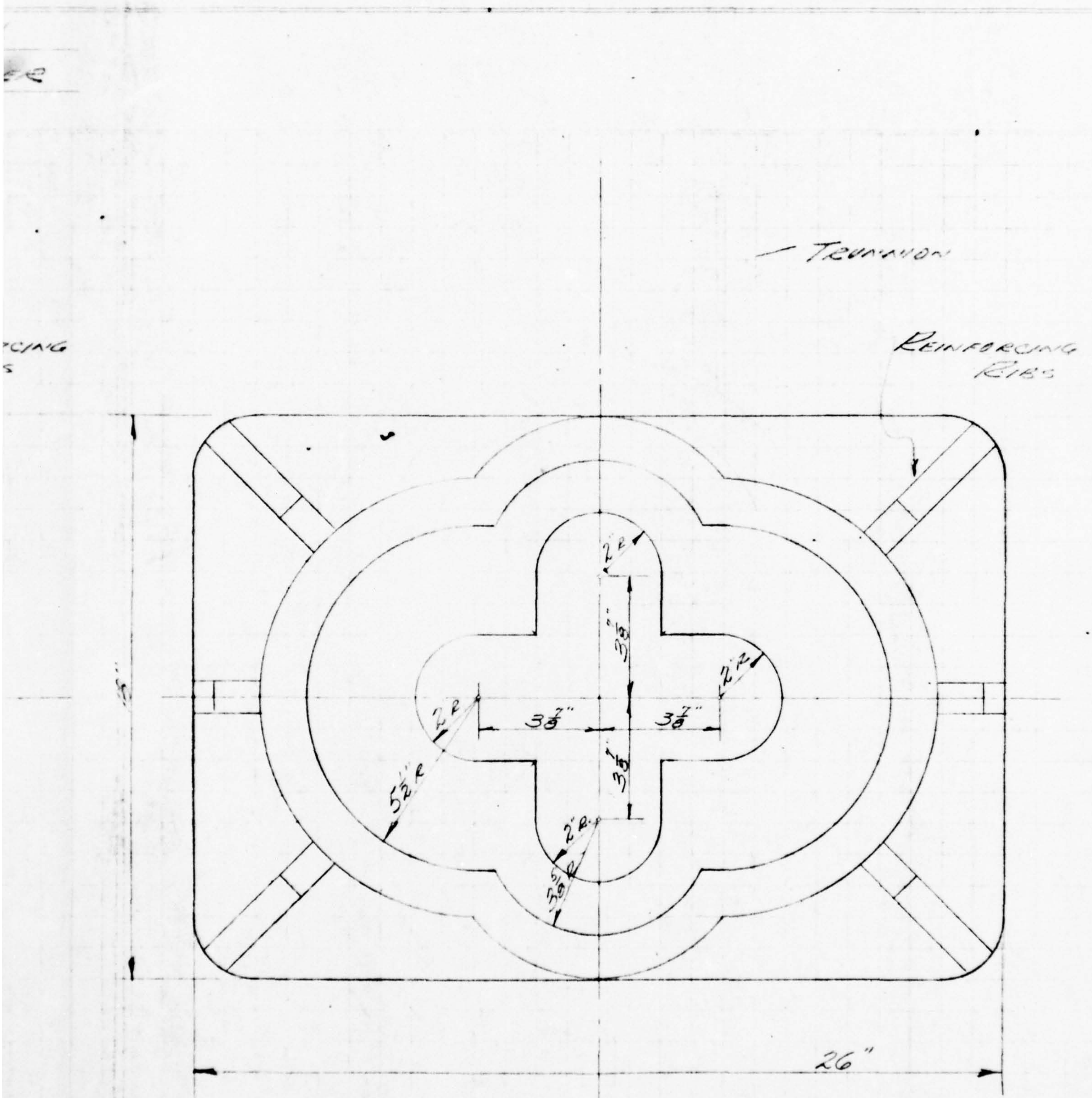
COMPANY U.S ARMY - ERDL
SHEET NO 3 of 4

SUBJECT Mono Mooring System - Chain Stopper

NUMBER J0 50617
COMPUTER
CHECKED BY
DATE 5-11-65



TOP VIEW



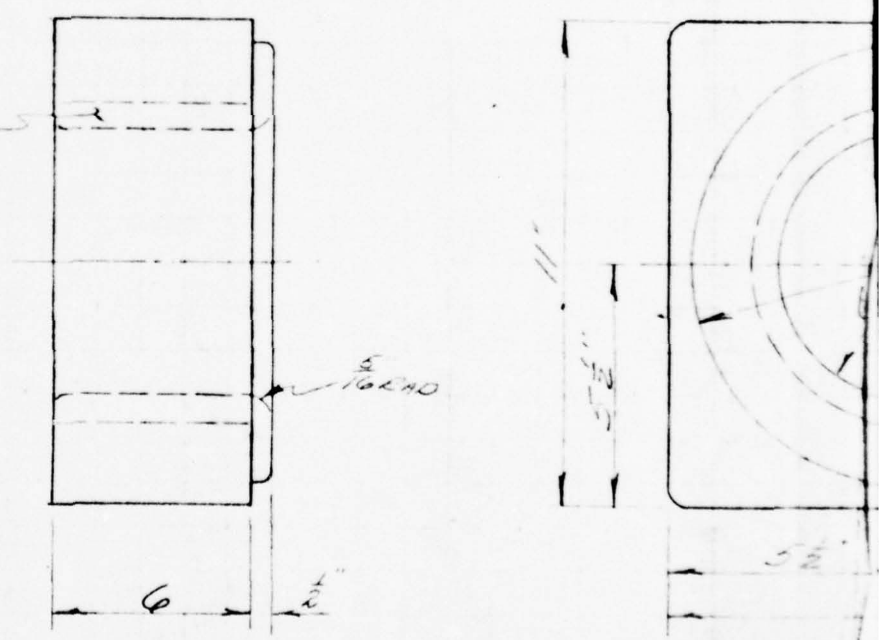
BOTTOM VIEW

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - ERDL	SHEET NO: 4 of 4
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER BAG	
DRAWING NUMBER: V.C. 56017	COMPUTER: [illegible]
CHECKED BY:	DATE: 5-24-65

TRUNNION B



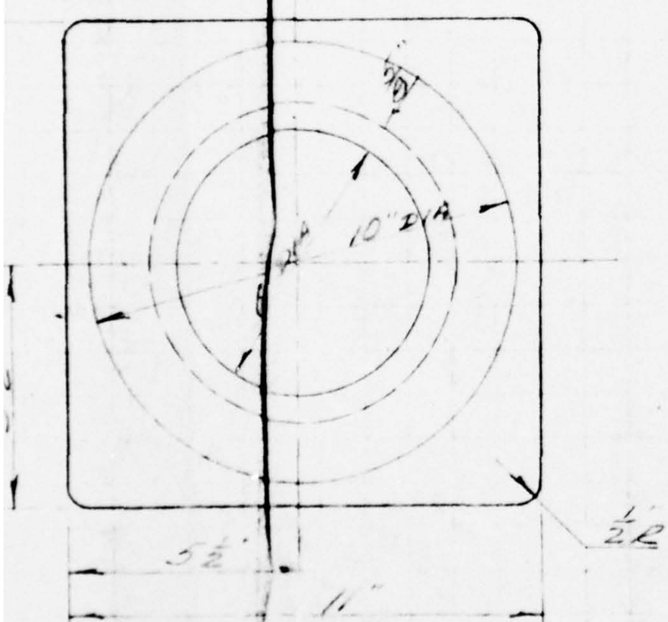
BEARING BLOC

...24

...G

...4-65

ON BEARING



...G BIDG

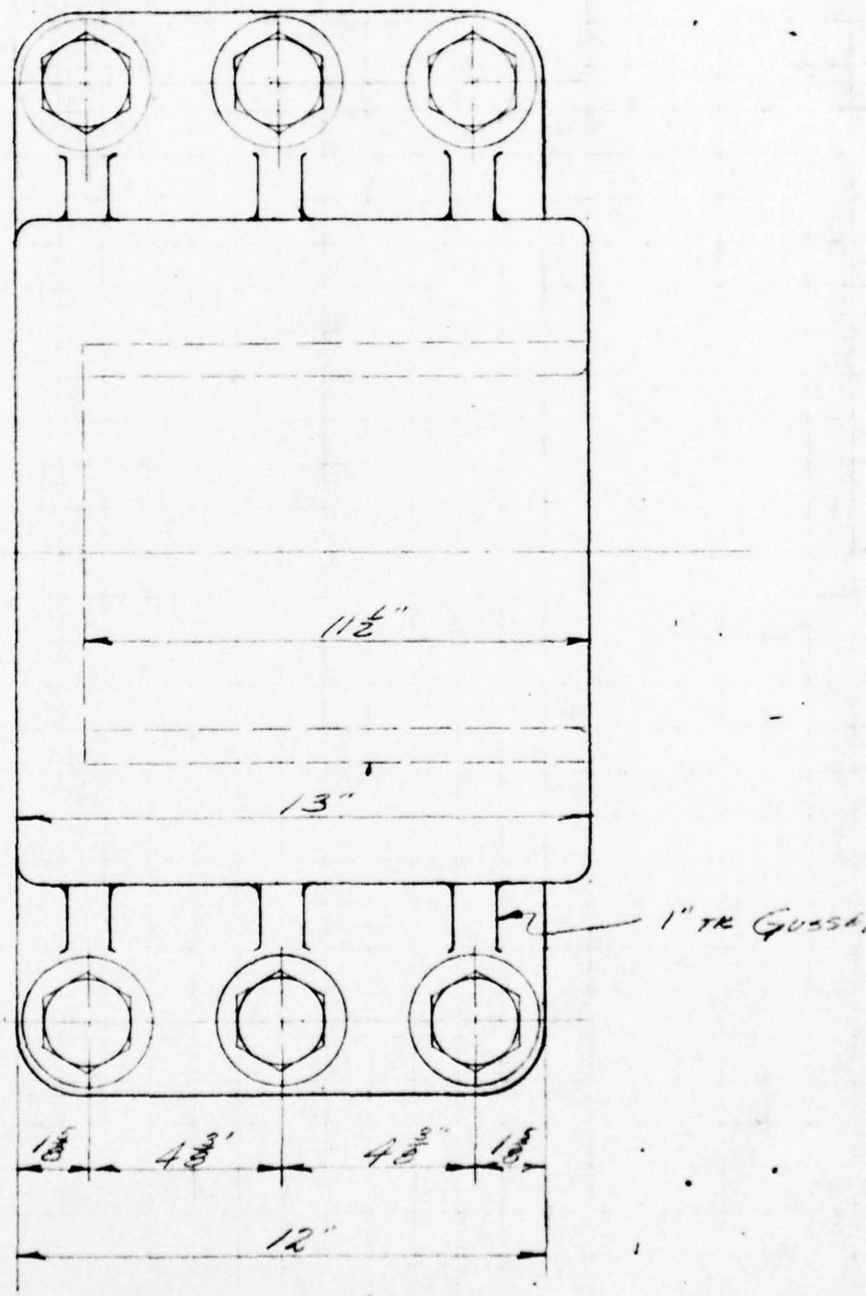
2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

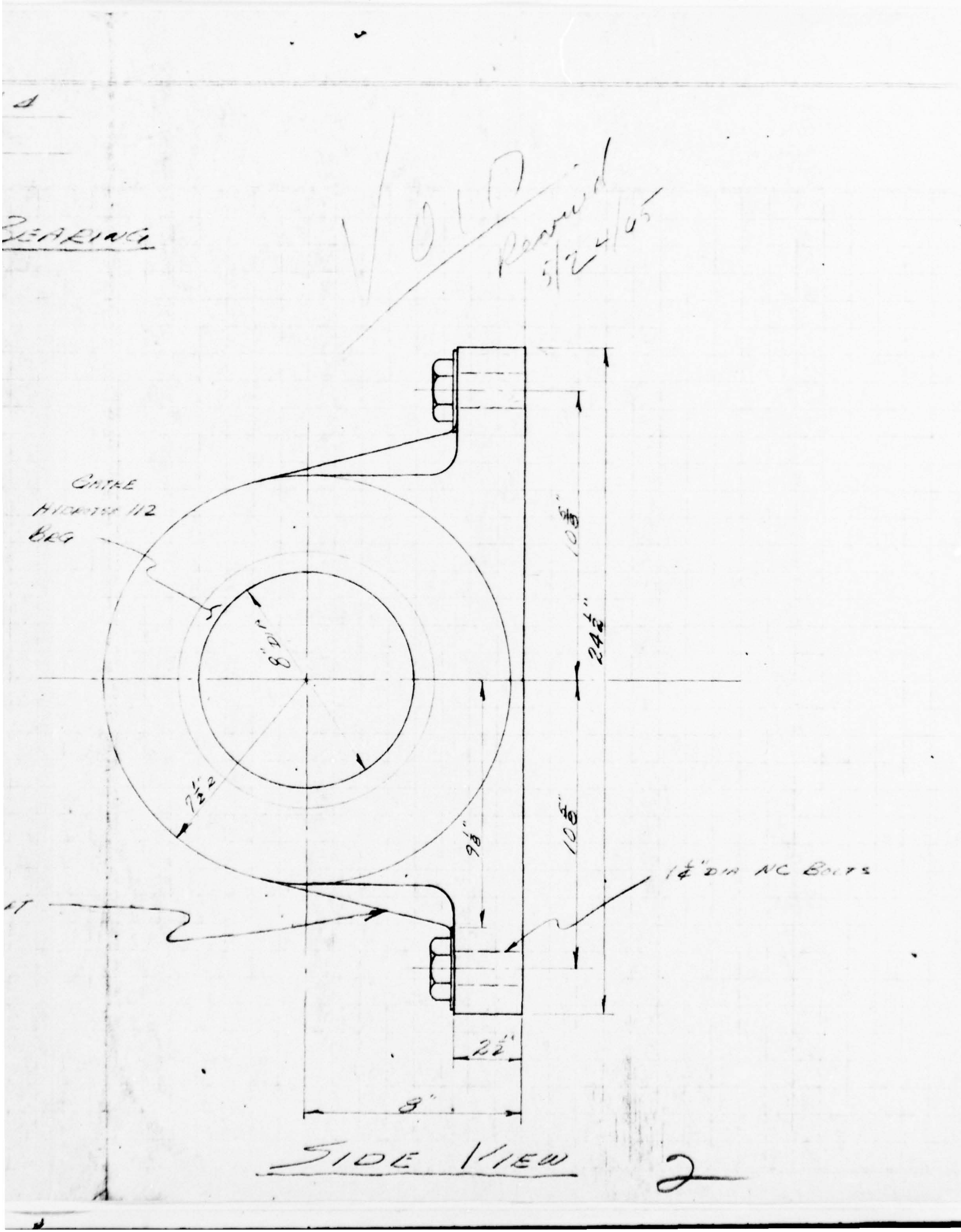
J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
U.S Army - ERDL			9 of 4
SUBJECT			
Mono Mooring System - Chain Stopper			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE

TRUNNION BEARI



TOP VIEW



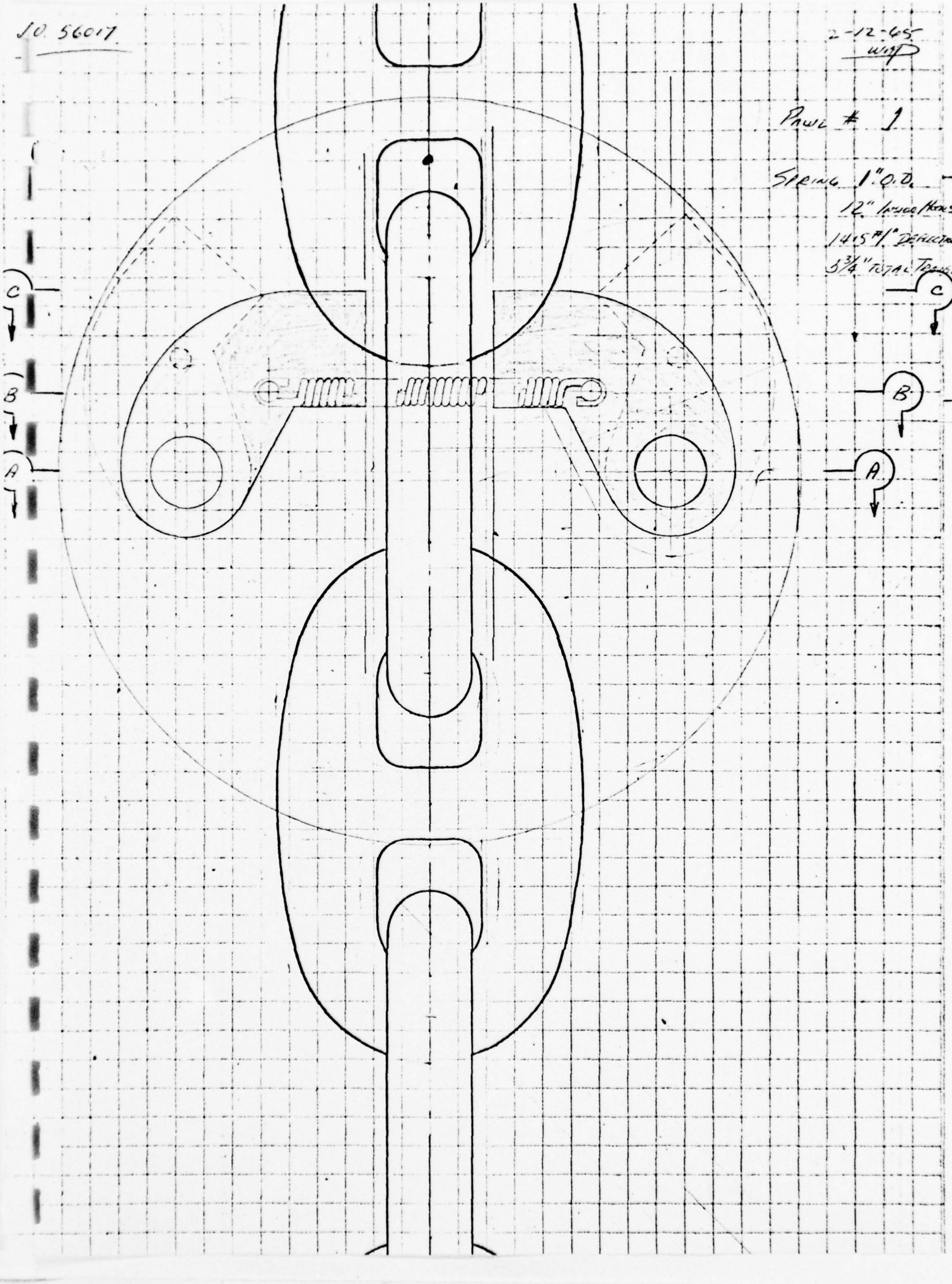
BEARING
VOID
Revised 5/24/05
GATKE
HIDRITE 112
BRG
8" DIA
$7\frac{1}{2}$" R
$9\frac{1}{8}$"
$10\frac{5}{8}$"
$24\frac{1}{2}$"
$10\frac{5}{8}$"
$1\frac{1}{4}$" DIA NC BOLTS
$2\frac{1}{2}$"
8"
SIDE VIEW
2

J.O. 56017

2-12-65
WMD

PAWL # 1

SPRING 1" O.D.
12" INSIDE HOOKS
14.5 #/1" DEFLECTION
3 3/4" TOTAL TRAVEL



COMPUTATION SHEET
ENGINEERING DEPARTMENT
CD 5011

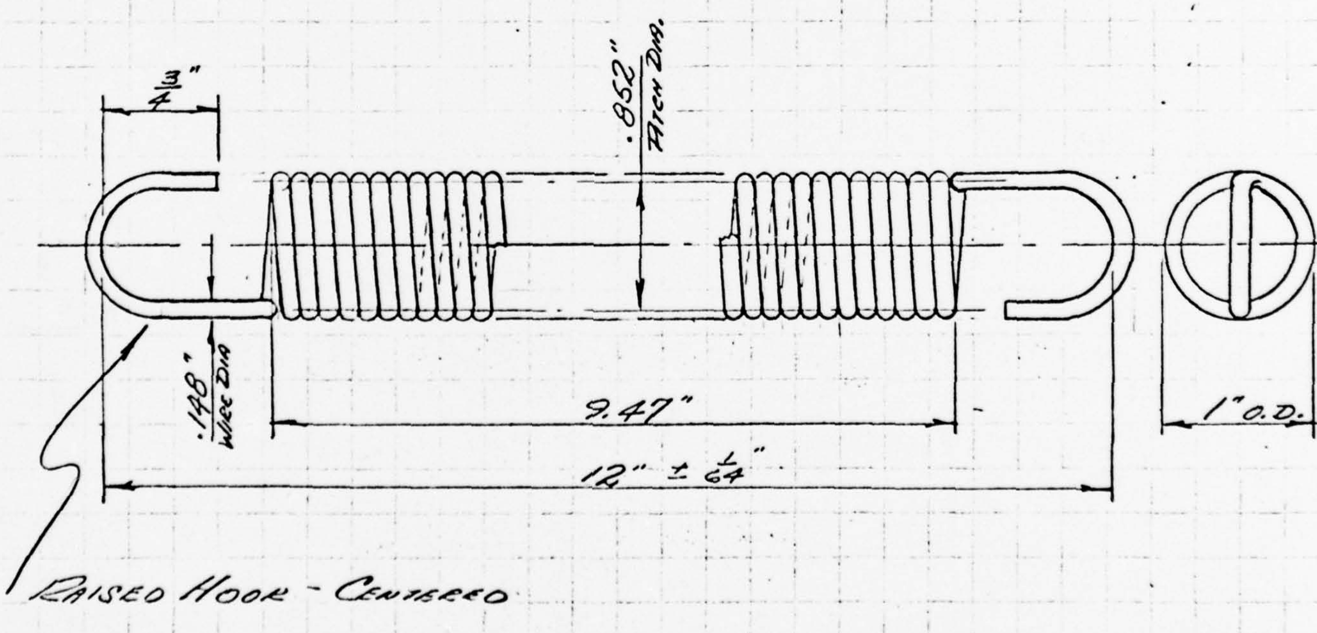
J. RAY McDERMOTT & CO., INC.

COMPANY	FIELD	SHEET NO.
U.S. ARMY - ERDL		1 of 1
SUBJECT	WELL NO.	DATE
MONO MOORING SYSTEM - CHAIN STOPPER		2/12/65
WING NO.	COMPUTER	
V.O 56017 SPRING CALCULATION	WAP	

MATERIAL:- SAE 30316 STAINLESS OR AS140 MONEL

WORKING SPECIFICATIONS:-

OUTSIDE DIA	1"
PITCH DIA	.852"
WIRE DIA	.148"
INITIAL TENSION	10 LBS
NO COILS	64
COIL LENGTH	9.47"
LENGTH INSIDE HOOKS	12"
APPROX SPRING RATE	14.5 LBS/" DEFLECTION
TOTAL DEFLECTION	6" MAX



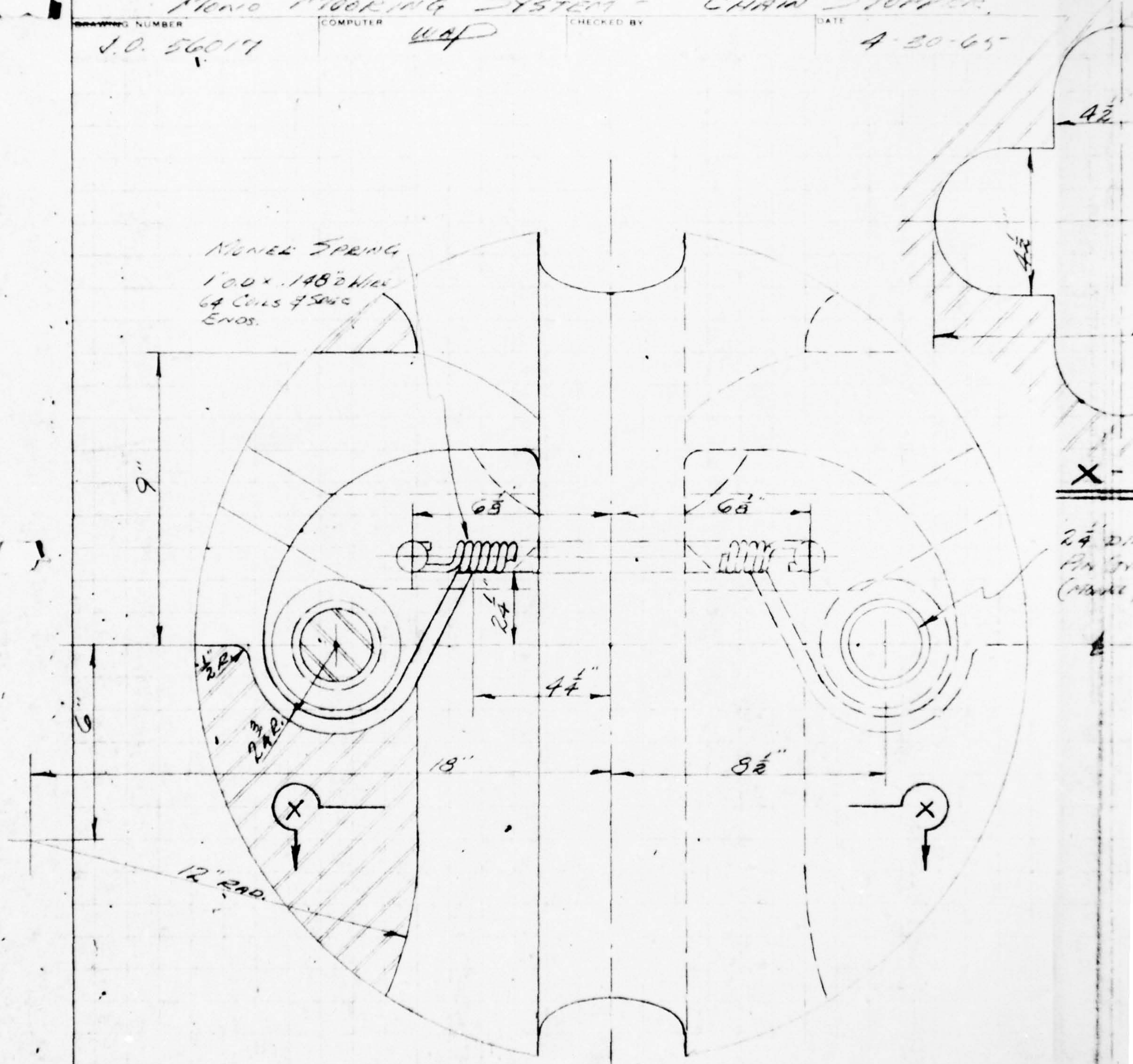
NOTE: TOTAL LOAD @ 6" DEFLECTION 95# ± 5%

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

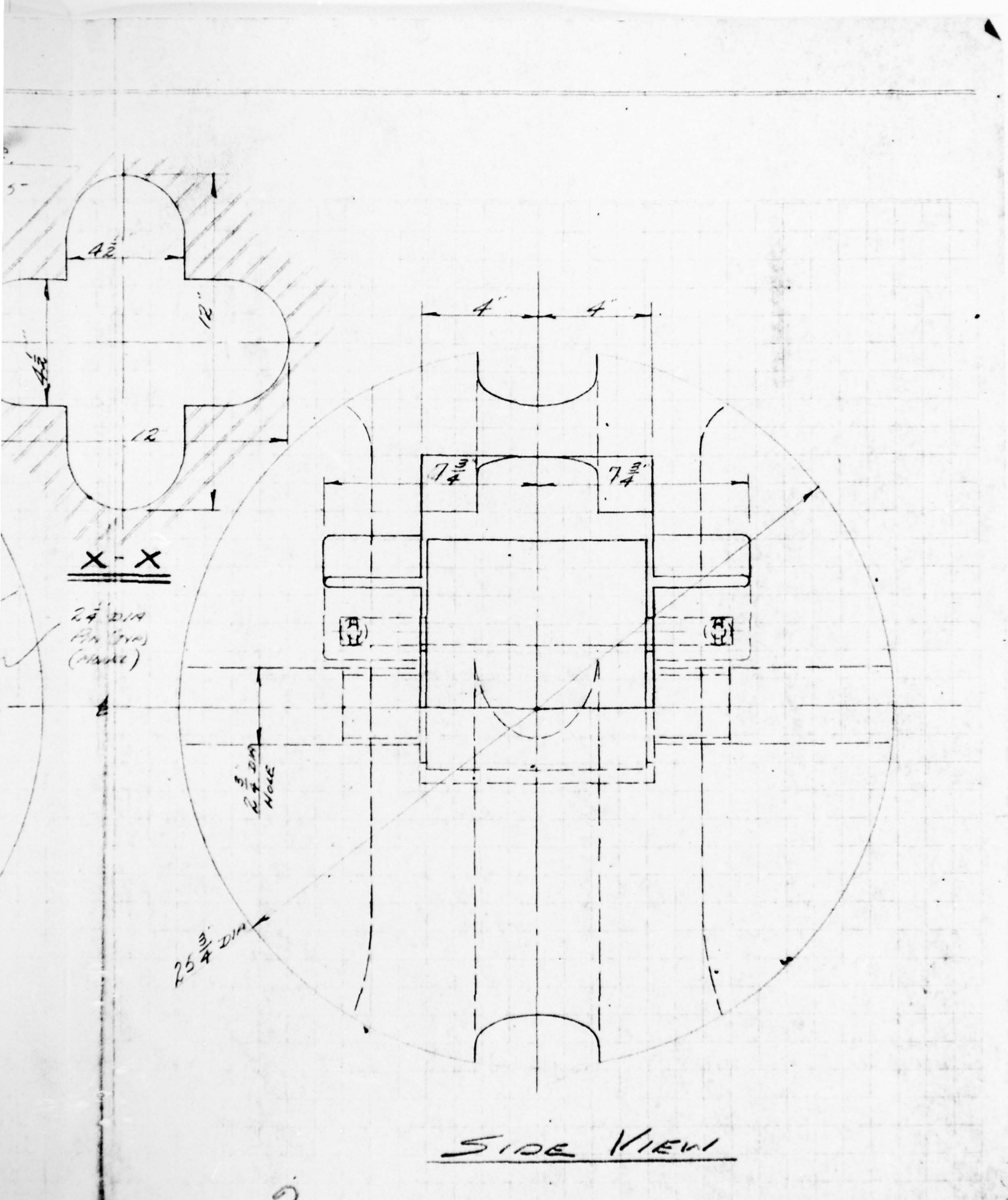
COMPANY	SHEET NO
U.S. ARMY - ERDL	

SUBJECT			
MENIO MOORING SYSTEM - CHAIN STOPPER			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAP		4-30-65



FRONT

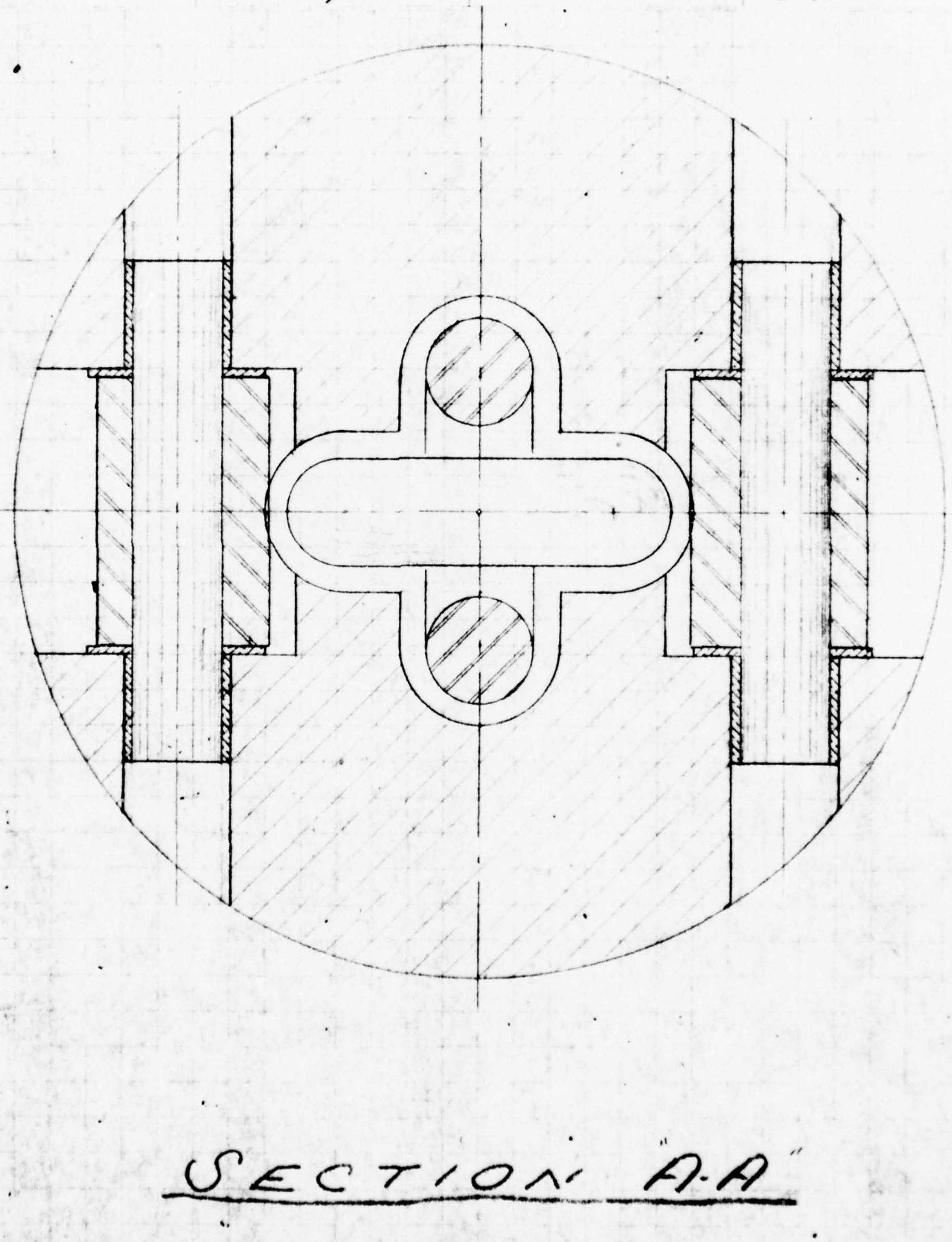
PARTIAL SECTIONAL VIEW


4½"
12"
4½"
12
X - X
4"
4"
7¾"
7¾"
2¾ DIA HOLE
25¾ DIA
SIDE VIEW

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

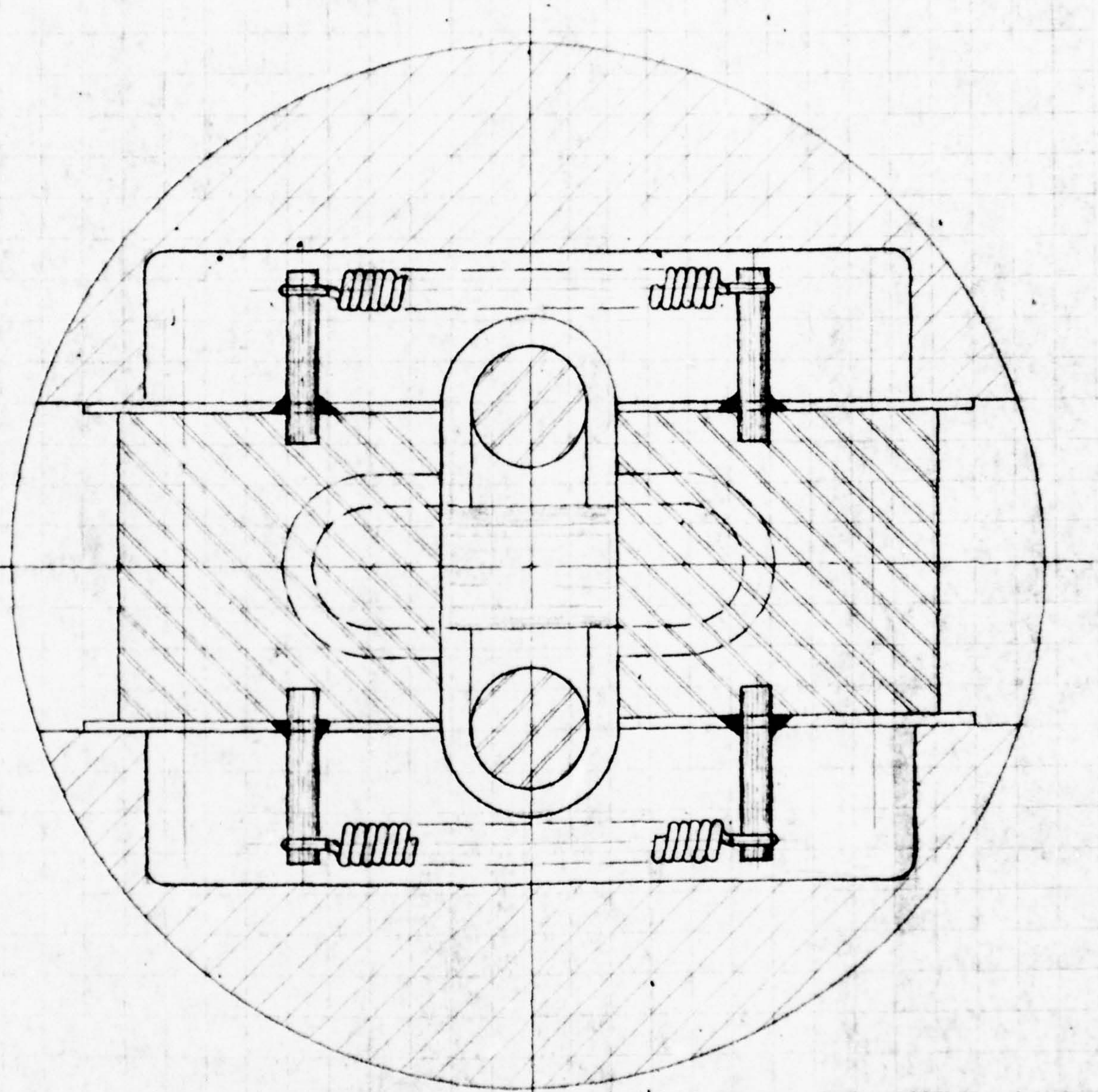
J. RAY McDERMOTT & CO., INC.

COMPANY: U. S. ARMY - E.R.D.L	SHEET NO
SUBJECT: MONO MOORING SYSTEM - AUTOMATIC CHAIN STOPPER	
DRAWING NUMBER	COMPUTER: WAP	CHECKED BY	DATE: 2-12-65



SECTION "A-A"

1



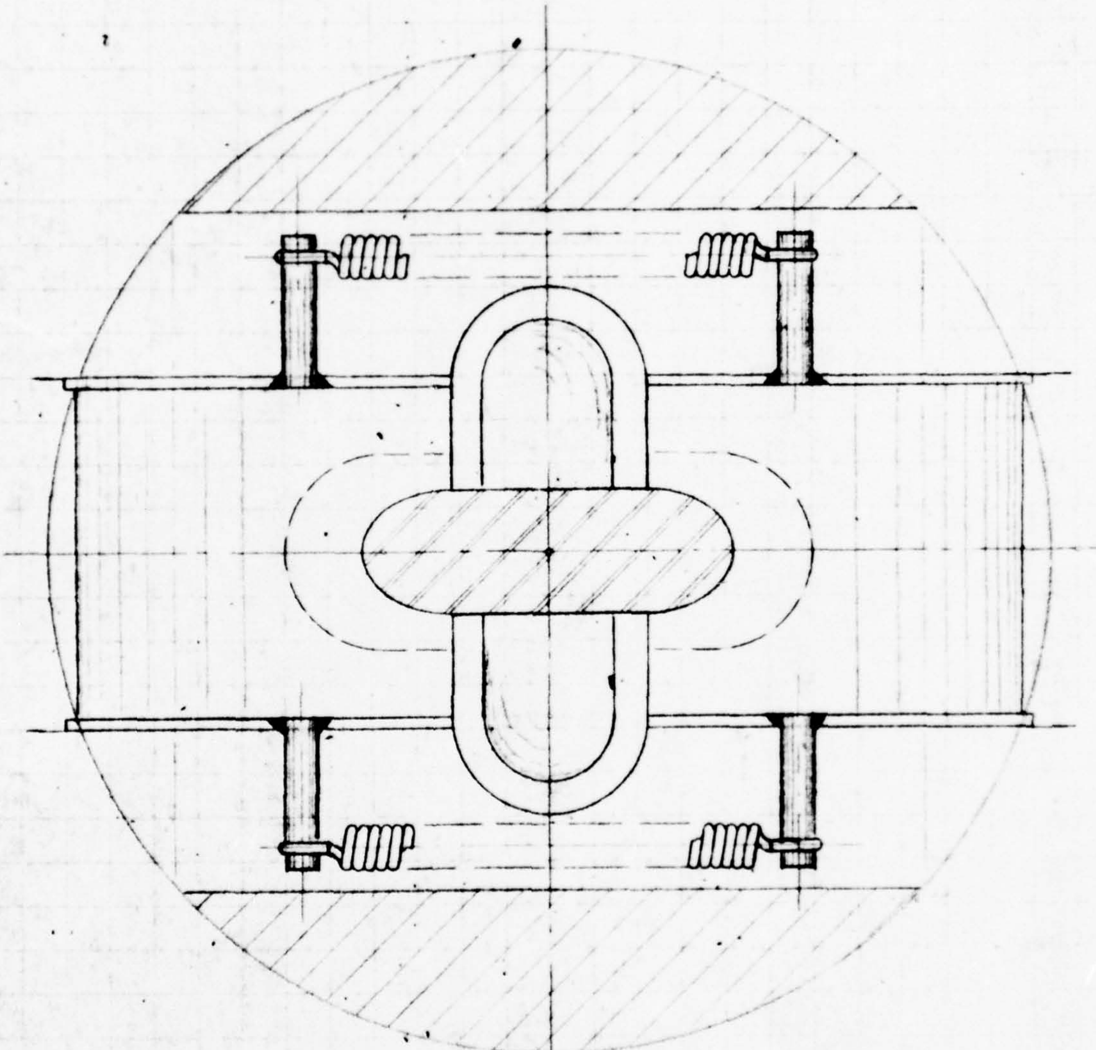
SECTION "B-B"

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD J4003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY ERDL
SHEET NO:
SUBJECT: MONO MOORING SYSTEM - AUTOMATIC CHAIN STOPP
DRAWING NUMBER:
COMPUTER: WHD
CHECKED BY:
DATE: 2-15-65



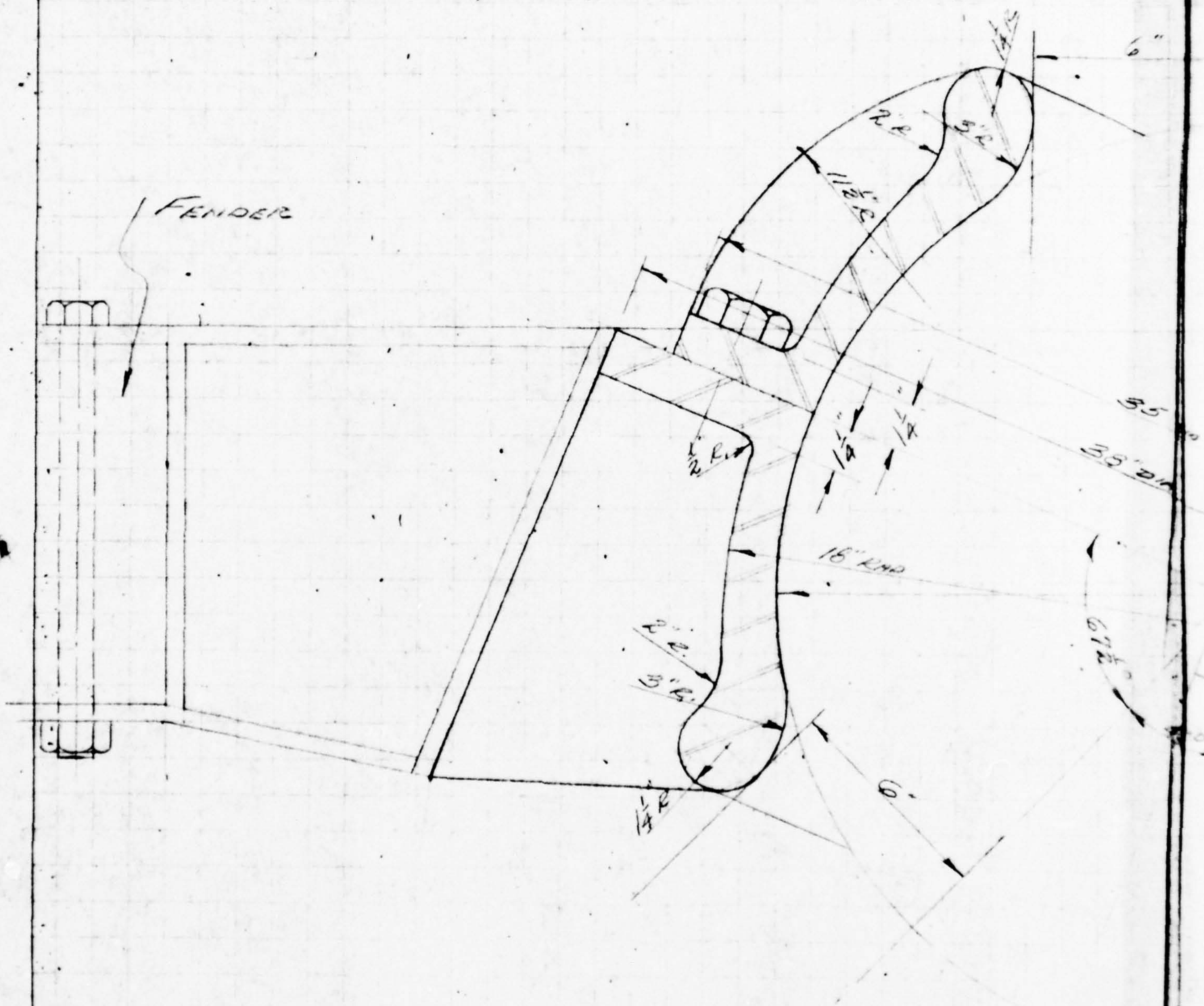
Storms

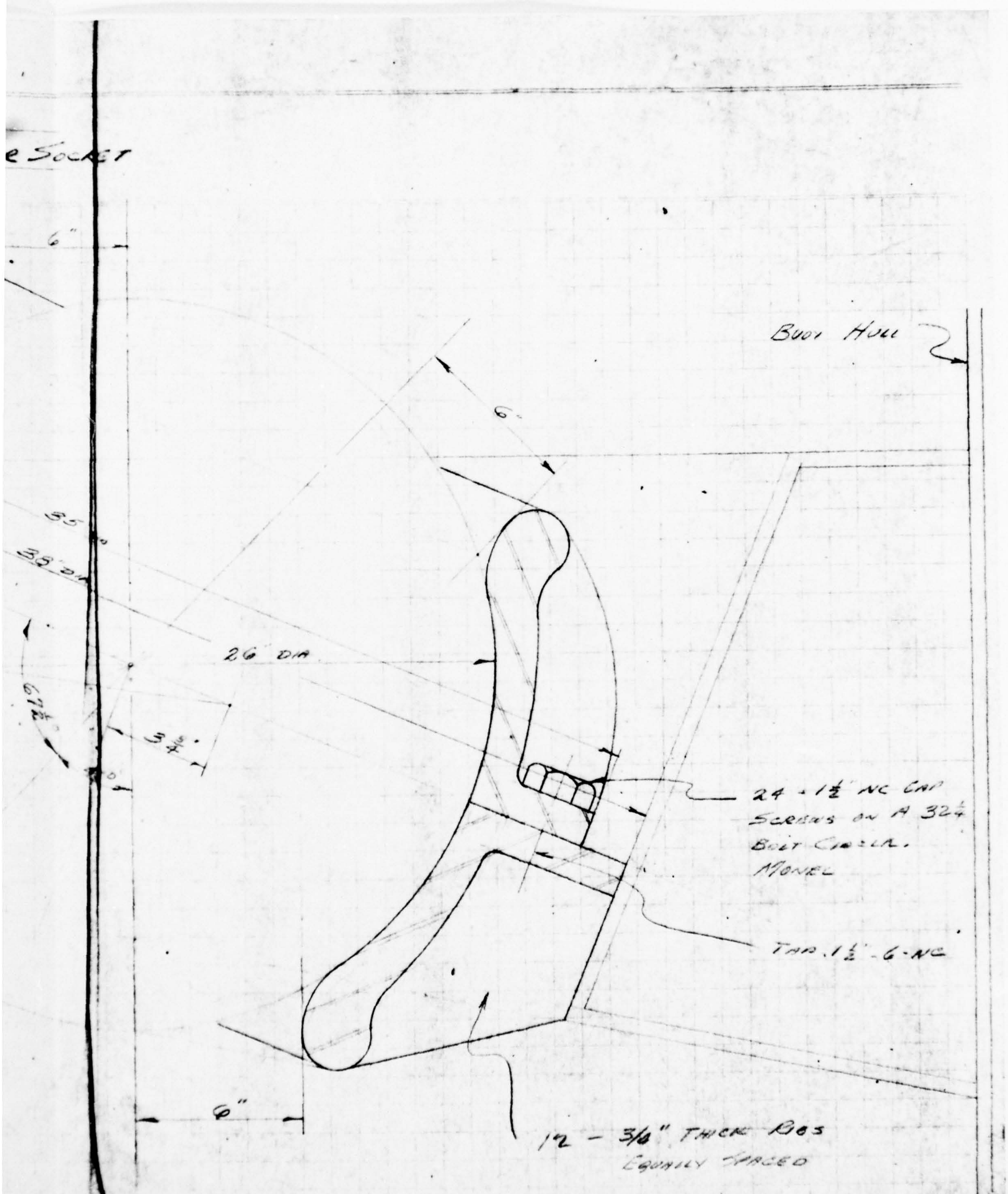
2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

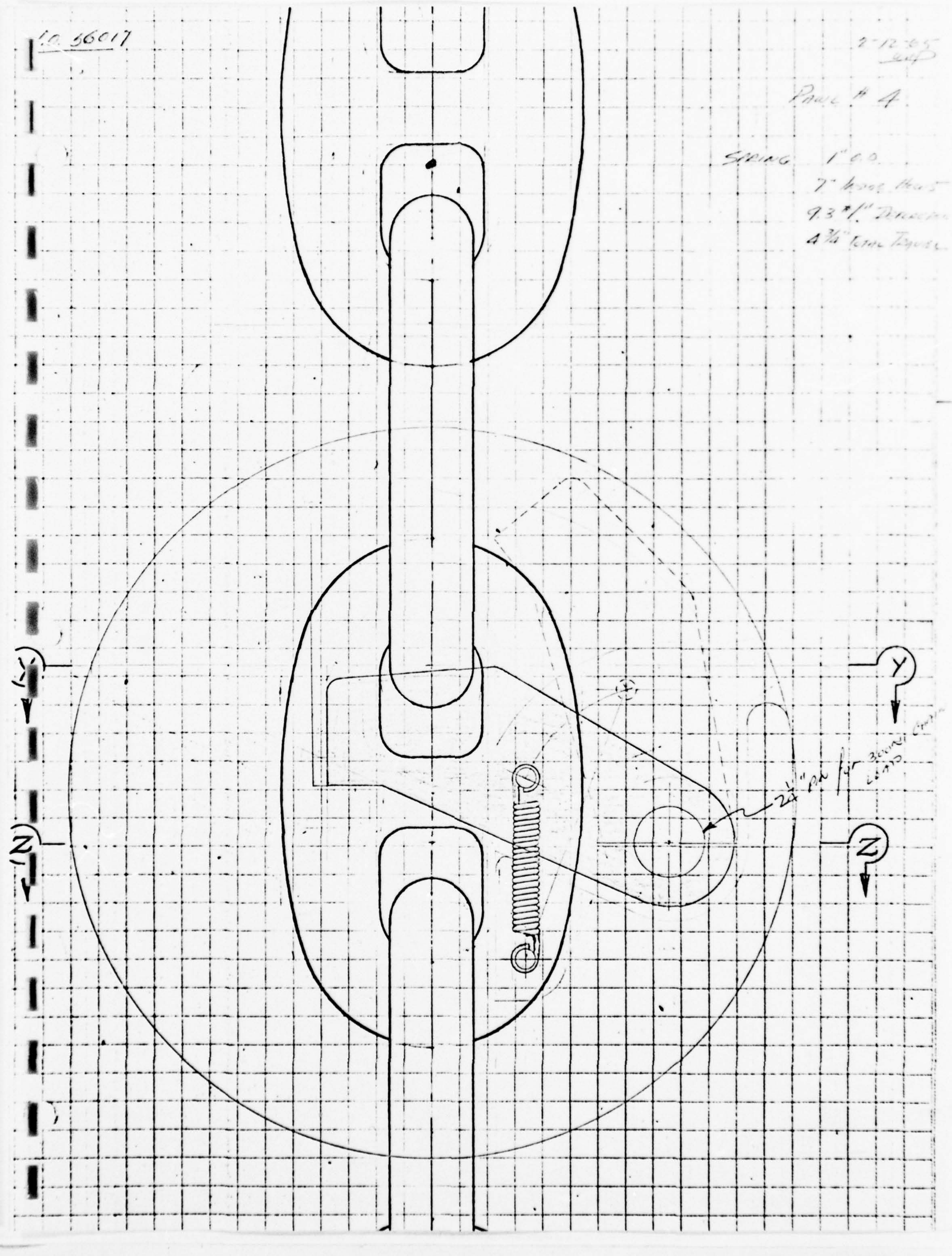
COMPANY			SHEET NO
U.S. ARMY ERDL			
SUBJECT: MONO MOORING SYSTEM - CHAIN STOPPER SOCK[E]			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE





e Socket
6"
Buoy Hull
6"
26 DIA
$3\frac{3}{4}$"
$67\frac{1}{2}$°
24 - $1\frac{1}{2}$" NC Cap
Screws on A $32\frac{1}{4}$
Bolt Circle.
Monel
Tap $1\frac{1}{2}$" - 6 - NC
6"
12 - 3/4" Thick Ribs
Equally Spaced

2.


2-12-65
Pawl # 4
Spring 1" O.D.
Y
Z

2-11-65
WF

PITCH DIA = .880 = D
WIRE DIA = .120 = d , d^3 = .0017 , d^4 = .0002
INITIAL TENSION = 5 # = P_i
NO COILS 37 = N
COIL LENGTH = 4.58"
LENGTH INSIDE HOOKS 7"
OUTSIDE DIA = 1"

INITIAL TENSIONING STRESS = $S = \frac{2.55 P_i D}{d^3}$

$$S = \frac{2.55 \times 5 \times .880}{.0017}$$

$$S = 6{,}600 \text{ PSI}$$

SPRING RATE: $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .0002}{8 \times .69 \times 37}$$

P = 9.3 #/" DEFLECTION

TORSIONAL STRESS = S_T = (USE 75,000 PSI ~~WIRE~~)

$$P_{MAX} = \frac{S_T \pi d^3}{16 R \frac{1}{14}}$$

$$P_{MAX} = \frac{75{,}000 \times 3.14 \times .0017}{16 \times .44 \times 1.15}$$

P_{MAX} = 49.4 # (MAX ALLOWABLE SAFE LOAD)

INITIAL TENSION = 5 # = P_1

NO COILS 37 = N

COIL LENGTH = 4.58"

LENGTH INSIDE HOOKS 7"

OUTSIDE DIA = 1"

<u>INITIAL TENSIONING STRESS</u> = $S = \frac{2.55 P_1 D}{d^3}$

$$S = \frac{2.55 \times 5 \times .880}{.0017}$$

$$S = 6{,}600 \text{ psi}$$

SPRING RATE: $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .0002}{8 \times .69 \times 37}$$

$P = 9.3$ #/" DEFLECTION

TORSIONAL STRESS = S_T = (USE 75,000 psi <u>Hirel</u>)

$$P_{MAX} = \frac{S_T \pi d^3}{16 R \frac{r_1}{r_4}}$$

$$P_{MAX} = \frac{75{,}000 \times 3.14 \times .0017}{16 \times .44 \times 1.15}$$

$P_{MAX} = 49.4$ # (MAX ALLOWABLE SAFE LOAD)

BENDING STRESS = $S_B = \frac{32 PR}{\pi d^3} \times \frac{r_1}{r_3}$

$$S_B = \frac{32 \times 49.4 \times .44}{3.14 \times .0017} \times 1.15$$

$$S_B = 149{,}000 \text{ psi}$$

DEFLECTION = $F = \frac{P_{MAX} - P_1}{P}$

$F = \frac{49.4 - 5}{9.3} = 4.77$" (MAX SAFE DEFLECTION

Extension Springs

An extension spring is a close-coiled helical spring that offers resistance to a pulling force. They are made from round and square wire; coils are usually close-wound and in contact with each other. They are different from compression springs from a loading standpoint, inasmuch as the coils may be wound so tightly together that an effort is required to pull them apart. This load built up by coiling is called initial tension and is a controllable factor to a certain extent.

To provide a satisfactory extension spring, or to intelligently quote on your inquiries, the following information should be given:

Specifications and Design of Extension Springs

Material

The material, if steel, may be specified as "Spring Steel Wire" if the choice of the grade of wire is to be left to the manufacturer.

If, however, a particular type or grade of material has been found to be satisfactory or necessary, full information should be given to assure satisfactory springs.

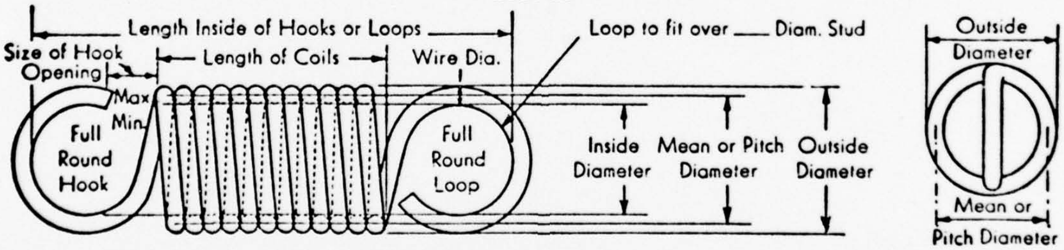
Wire Diameter

The wire diameter should be specified in decimals to avoid any confusion due to the various gauge tables. If no loads are specified on the blueprint, the wire will be maintained within the commercial tolerance for its size. If loads are specified, the wire diameter is then of secondary importance and may be changed in order to meet the load requirements.

Spring Diameter

While extension springs do not require a stud or hole to guide their action, few have unlimited operating space, and necessary clearances between component parts must be maintained. If spring operates in a hole

FIG. 11



To provide a satisfactory extension spring, or to quote intelligently on inquiries, the following information should be given:

Material SAE 30316 STAINLESS ~~[illegible]~~

Working Specifications *(Fill in required data only)*

Max. outside diameter 1"

Min. inside diameter ____

Initial tension 5#

To support 50 ***lbs. ±*** ____ ***lbs. at*** 4 3/4 ***inches***

To support ____ ***lbs. ±*** ____ ***lbs. at*** ____ ***inches***

Rate per inch 9.3#

Max. extended length without set 4 3/4"

Direction of coil RH OR LH

Position of loops CENTERED

Type of ends FULL ROUND LOOP

Suggested Specifications

If no loads are given maintain as required specifications

Wire diameter .120

Outside diameter 1"

Total number of coils 37

Free length inside loops 7"

Special Information

____

____

1

2-11-65
WJ

PITCH DIA .865 = D
WIRE DIA .135 = d, d^3 = .0024, d^4 = .00033
INITIAL TENSION 5# = P_1
NO COILS 41 = N
COIL LENGTH 5.67"
LENGTH INSIDE HOOKS 8"
OUTSIDE DIA 1"

INITIAL TENSIONING STRESS = $S = \frac{2.55 P D}{d^3}$

$$S = \frac{2.55 \times 5 \times .865}{.0024}$$

$$S = 4{,}600 \text{ psi}$$

SPRING RATE = $P = \frac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .00033}{8 \times .65 \times 41}$$

$$P = 14.75 \text{ \#/" DEFLECTION}$$

TORSIONAL STRESS = S_T = (USE 75,000 psi MONEL)

$$P_{max} = \frac{S_T \pi d^3}{16 R \frac{r_1}{r_4}}$$

$$P_{max} = \frac{75{,}000 \times 3.14 \times .0024}{16 \times .\cancel{4}32 \times 1.15}$$

$$P_{max} = 71\text{\#} \text{ (MAX ALLOWABLE SAFE LOAD)}$$

BENDING STRESS = $S_B = \frac{32 P R}{\pi d^3} \times \frac{r_1}{r_3}$

$$S_B = \frac{32 \times 71 \times .432}{3.14 \times .0024} \times 1.15$$

$$S_B = 149{,}000 \text{ psi}$$

DEFLECTION = $F = \frac{P_{max} - P_1}{P}$

INITIAL TENSION 5# = P_1

NO COILS 41 = N

COIL LENGTH 5.67"

LENGTH INSIDE HOOKS 8"

OUTSIDE DIA 1"

INITIAL TENSIONING STRESS = $S = \dfrac{2.55 P D}{d^3}$

$$S = \frac{2.55 \times 5 \times .865}{.0024}$$

$$S = 4{,}600 \text{ psi}$$

SPRING RATE = $P = \dfrac{G d^4}{8 D^3 N}$

$$P = \frac{9.5 \times 10^6 \times .00053}{8 \times .65 \times 41}$$

$$P = 14.75 \ \#/'' \text{ DEFLECTION}$$

TORSIONAL STRESS = S_T = (USE 75,000 psi MONEL)

$$P_{max} = \frac{S_T \, \pi \, d^3}{16 \, R \, \frac{r_1}{r_4}}$$

$$P_{max} = \frac{75{,}000 \times 3.14 \times .0024}{16 \times .432 \times 1.15}$$

$$P_{max} = 71^{\#} \text{ (MAX ALLOWABLE SAFE LOAD)}$$

BENDING STRESS = $S_B = \dfrac{32 \, P R}{\pi \, d^3} \times \dfrac{r_1}{r_3}$

$$S_B = \frac{32 \times 71 \times .432}{3.14 \times .0024} \times 1.15$$

$$S_B = 149{,}000 \text{ psi}$$

DEFLECTION = $F = \dfrac{P_{max} - P_1}{P}$

$$F = \frac{71 - 5}{14.75} = 4.48'' \text{ (MAX SAFE DEFLECTION)}$$

7

Extension Springs

An extension spring is a close-coiled helical spring that offers resistance to a pulling force. They are made from round and square wire; coils are usually close-wound and in contact with each other. They are different from compression springs from a loading standpoint, inasmuch as the coils may be wound so tightly together that an effort is required to pull them apart. This load built up by coiling is called initial tension and is a controllable factor to a certain extent.

To provide a satisfactory extension spring, or to intelligently quote on your inquiries, the following information should be given:

Specifications and Design of Extension Springs

Material

The material, if steel, may be specified as "Spring Steel Wire" if the choice of the grade of wire is to be left to the manufacturer.

If, however, a particular type or grade of material has been found to be satisfactory or necessary, full information should be given to assure satisfactory springs.

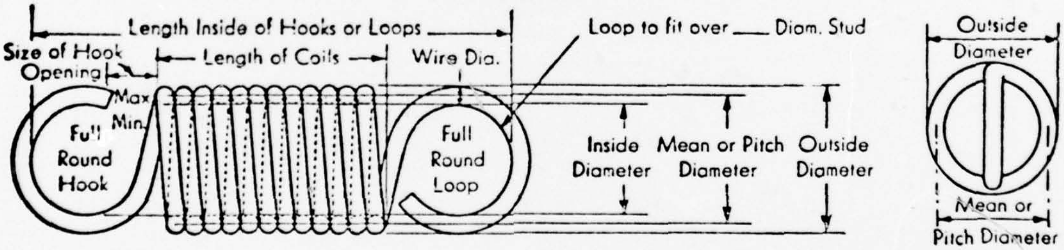
Wire Diameter

The wire diameter should be specified in decimals to avoid any confusion due to the various gauge tables. If no loads are specified on the blueprint, the wire will be maintained within the commercial tolerance for its size. If loads are specified, the wire diameter is then of secondary importance and may be changed in order to meet the load requirements.

Spring Diameter

While extension springs do not require a stud or hole to guide their action, few have unlimited operating space, and necessary clearances between component parts must be maintained. If spring operates in a hole

FIG. 11



To provide a satisfactory extension spring, or to quote intelligently on inquiries, the following information should be given:

Material ~~A.S.T. ...~~ SAE 30316 STAINLESS

Working Specifications *(Fill in required data only)*

Max. outside diameter 1"

Min. inside diameter ____

Initial tension 5#

To support 70 ***lbs. ±*** ____ ***lbs. at*** 4 1/2 ***inches***

To support ____ ***lbs. ±*** ____ ***lbs. at*** ____ ***inches***

Rate per inch 14.75 #

Max. extended length without set 4 1/2"

Direction of coil RH or LH

Position of loops CENTERED

Type of ends FULL ROUND LOOP

Suggested Specifications

If no loads are given maintain as required specifications

Wire diameter .135

Outside diameter 1"

Total number of coils 41

Free length inside loops 8"

Special Information

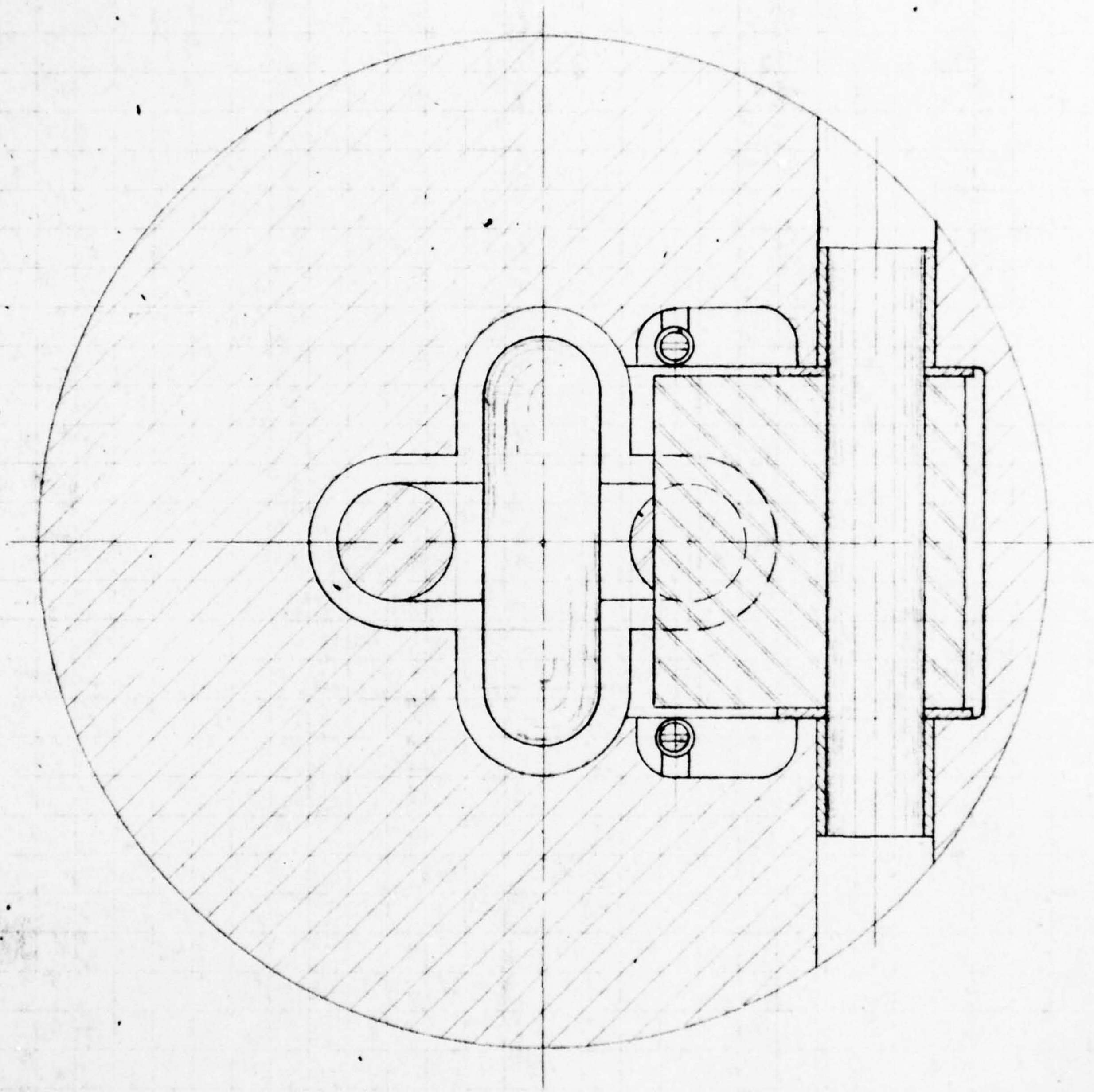
____

____

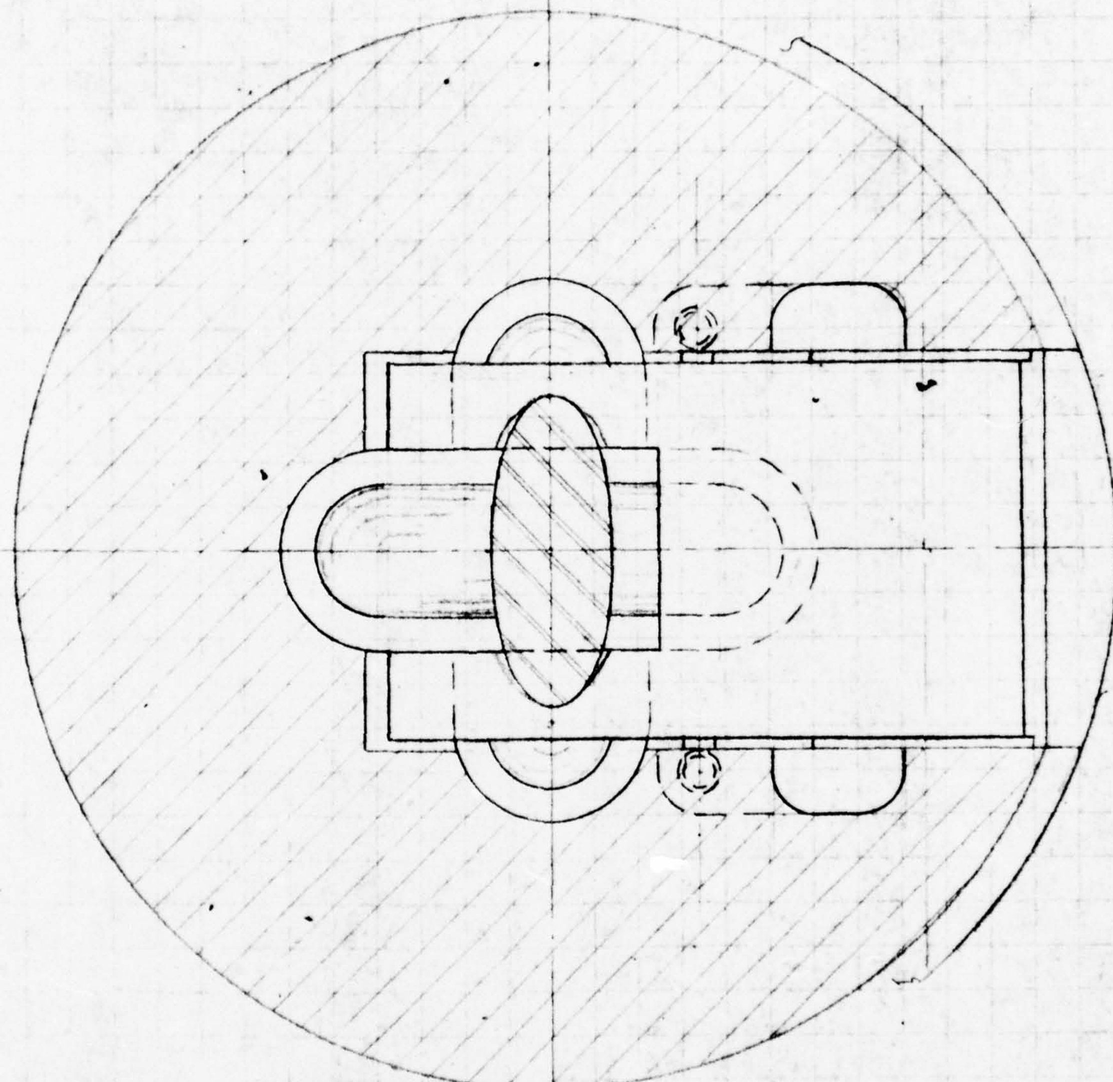
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - E.R.D.L.
SHEET NO:
SUBJECT: MONO MOORING SYSTEM - AUTOMATIC CHAIN STOPPER
DRAWING NUMBER:
COMPUTER: WHP
CHECKED BY:
DATE: 2-15-65



SECTION Z-Z



SECTION "Y-Y"

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

Job 56017

COMPANY	SHEET NO 1 of
SUBJECT: Mono Mooring System	

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-18-64

Mooring Windlass Calculations

Design Load:-

Chain Tensioning Load	28.3^{K}/chain
Hawse Pipe Friction = 40% :	11.3^{K}
Net Effective Chain Load	39.6^{K}

Chain Take Up Speed

10 ft/min.

Efficiencies:- (Assumed)

Wildcat & Bearings	.95
Power Gearing	.64
Hydraulic Unit & Piping	.70
Overall	.425

Chain H.P.:-

$$\frac{39.6 \times 10}{33} = 12 \text{ HP}$$

H.P. to Power Gearing Input Shaft:-

$$\frac{12}{.95 \times .64} + 5 \text{(HP to turn idle wildcat - no load)} =$$

$$19.8 + 5 = 24.8 \text{ HP}$$

H.P. Reqd to Tension One Chain to Net Eff. Load (Hydraulic Motor)

$$\frac{24.8}{.70} = 35.4 \text{ HP}$$

Gear Ratio:-

10:1 @ Wildcat Secondary
30:1 @ Power Supply Primary

$$\frac{10 \times 30}{1 \times 1} = 300:1$$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5015

J. RAY McDERMOTT & CO., INC.

JOB 56017

COMPANY	SHEET NO
	2 of

SUBJECT: MONO MOORING SYSTEM

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-18-64

EFFECTIVE P.D. of WILDCAT:-

BASED ON $2\frac{7}{8}$" CHAIN SIZE
LENGTH 1 LINK = $17\frac{1}{4}$"
THICKNESS OF LINK = $2\frac{7}{8}$"

P.D. for STD 5 WHELP WILDCAT
LENGTH 10 LINKS = $10\left(17\frac{1}{4} - (2 \times 2\frac{7}{8})\right) = 115$"

$$\frac{115}{3.1416} = 36.8\text{" P.D} \qquad \frac{115}{12} = 9.6'$$

P.D. for 4 WHELP WILDCAT
LENGTH 8 LINKS = $8\left(17\frac{1}{4} - (2 \times 2\frac{7}{8})\right) = 92$"

$$\frac{92}{3.1416} = 29.3\text{" PD} \qquad \frac{92}{12} = 8.66'$$

WILDCAT R.P.M.:- (for 10 FT/MIN CHAIN SPEED)

for 5 WHELP WILDCAT

$$\frac{10}{9.6} = 1.04 \text{ RPM}$$

for 4 WHELP WILDCAT

$$\frac{10}{8.66} = 1.15 \text{ RPM}$$

MAIN SHAFT TORQUE:—

for 5 WHELP WILDCAT

$$\frac{39.6^{K} \times 36.8}{2 \times .95} = 767{,}000 \text{ \#"}$$

for 4 WHELP WILDCAT

$$\frac{39.6 \times 29.3}{2 \times .95} = 610{,}000 \text{ \#"}$$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5015

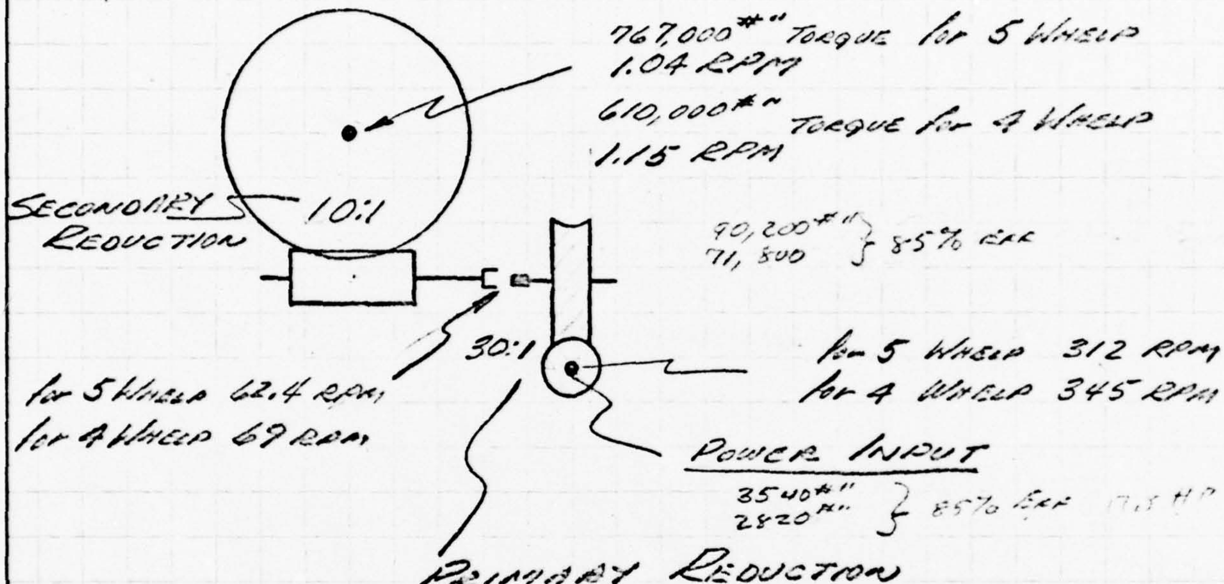
J. RAY McDERMOTT & CO., INC.

JOB 56017

COMPANY	SHEET NO 3 of
SUBJECT: MONO MOORING SYSTEM	

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-18-64

GEARING:-

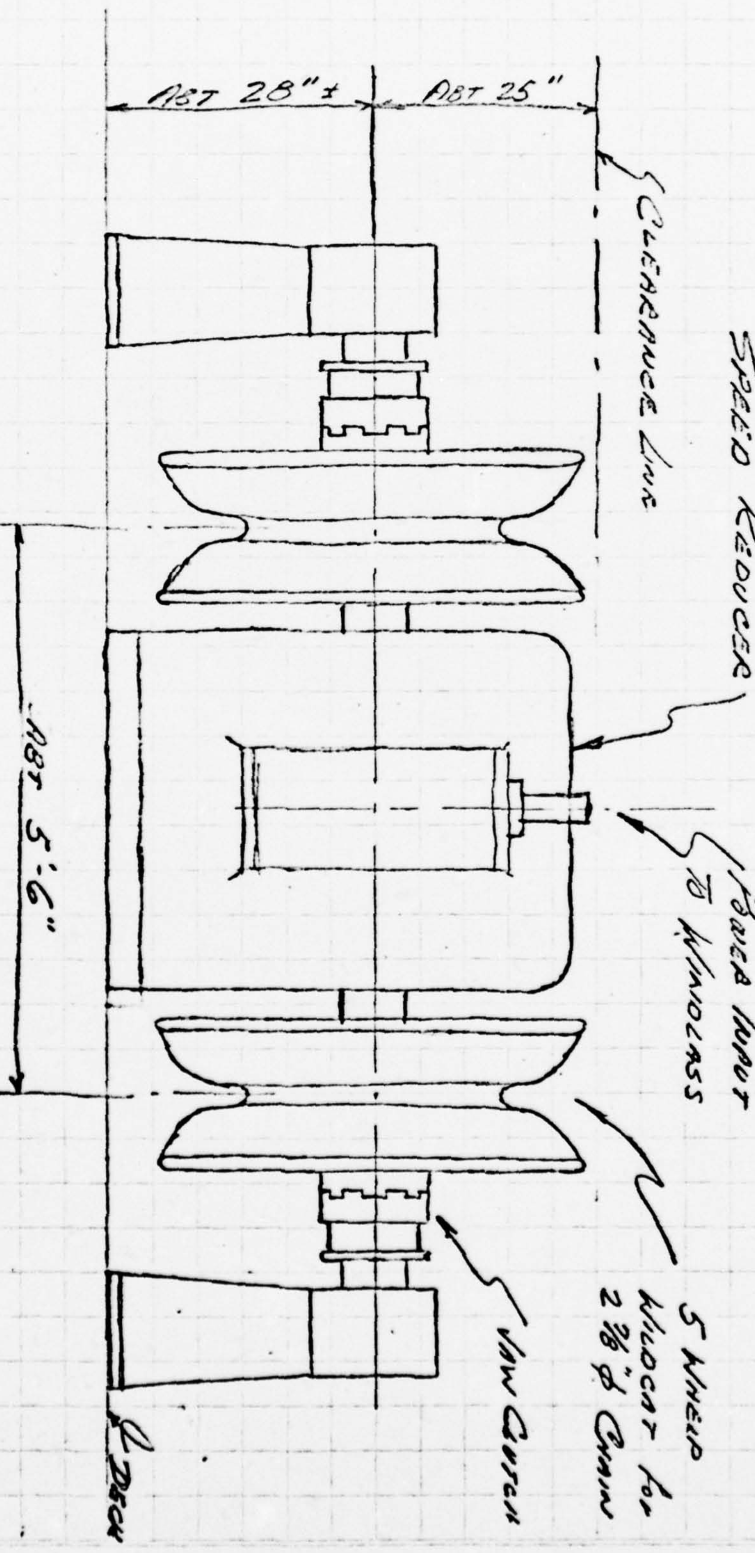


ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

JOB 56017

COMPANY			SHEET NO.
SUBJECT: Mono Mooring System			
DRAWING NUMBER	COMPUTER: WAP	CHECKED BY	DATE: 12-21-64



ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

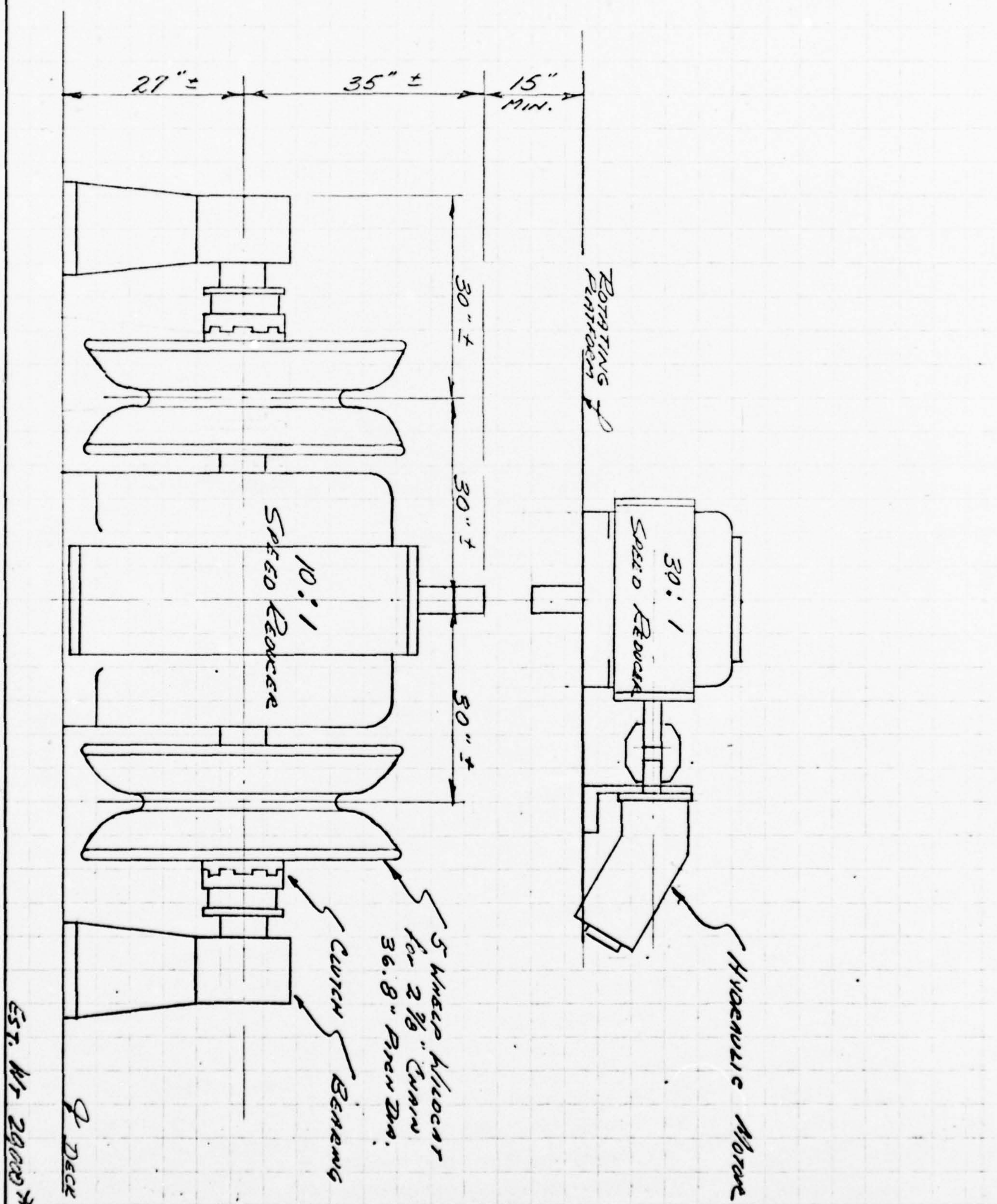
J. RAY McDERMOTT & CO., INC.

Job 56017

COMPANY	SHEET NO.

SUBJECT: Mono Mooring System

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		12-22-67



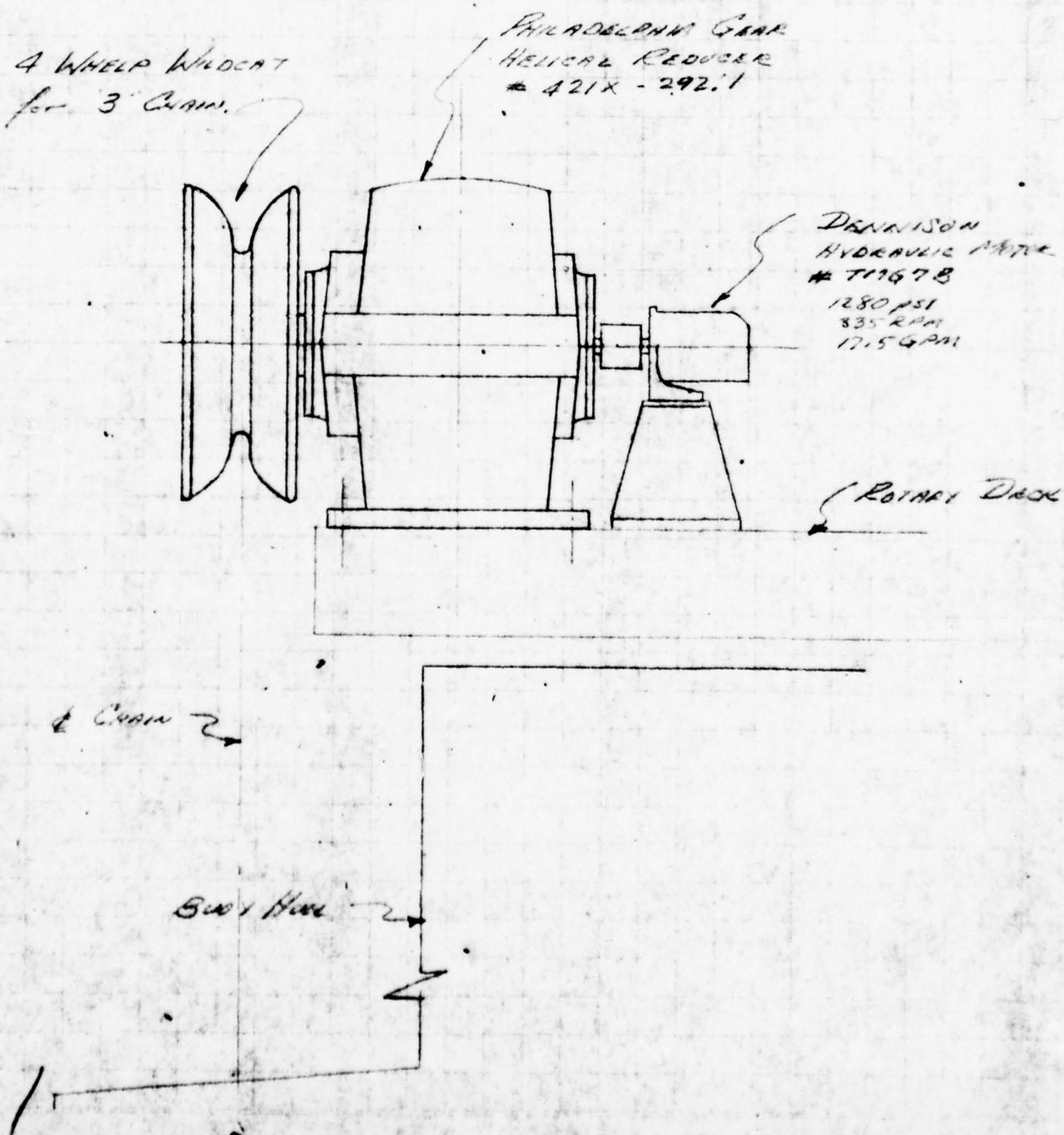
Est. Wt 20,000 #

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

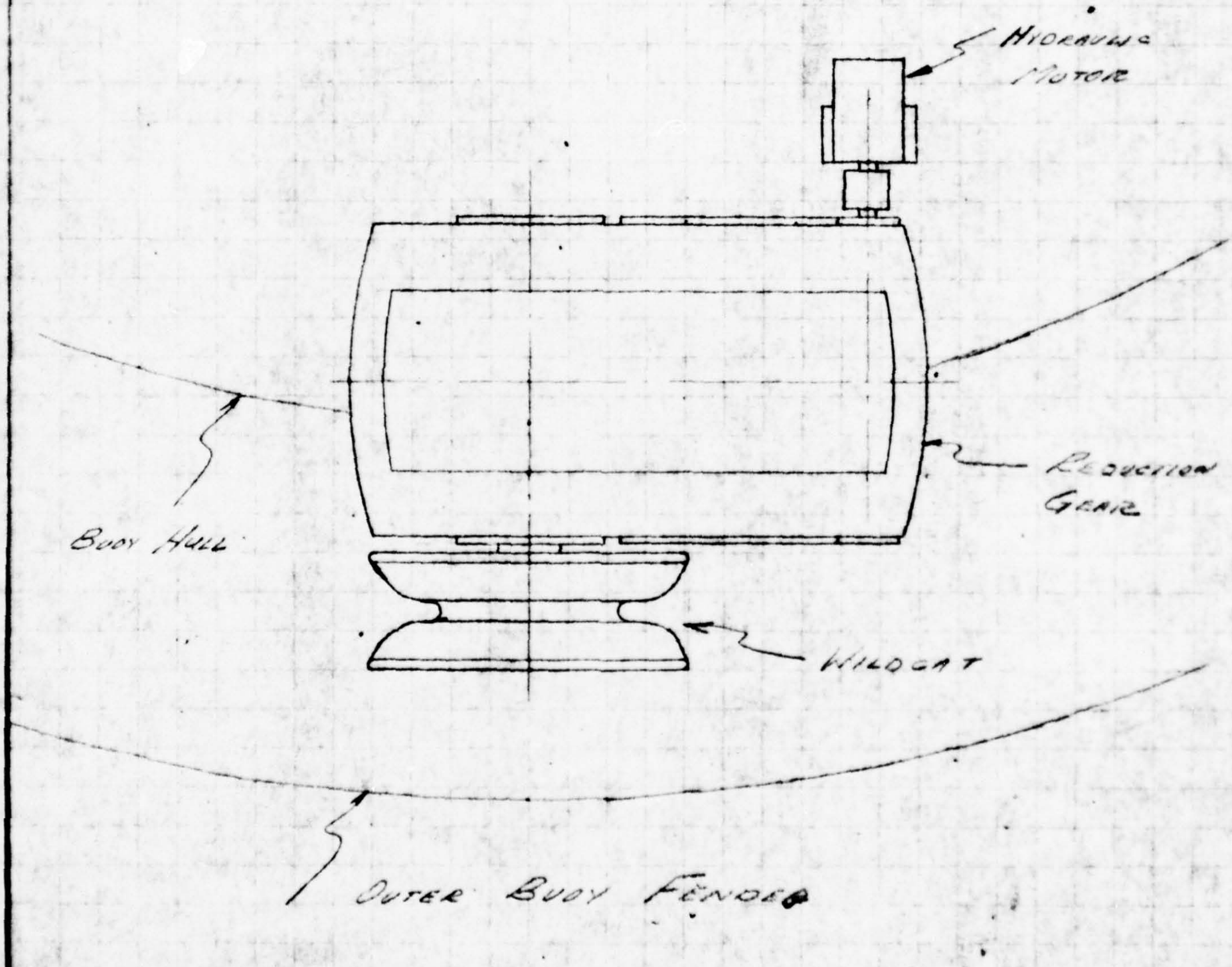
J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO.
U.S. ARMY - E.R.D.L.			
SUBJECT: MONO MOORING SYSTEM			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAF		2-16-65

SECTION



PLAN



HYDRAULIC MOTOR
REDUCTION GEAR
BUOY HULL
WILDCAT
OUTER BUOY FENDER

12,000 #

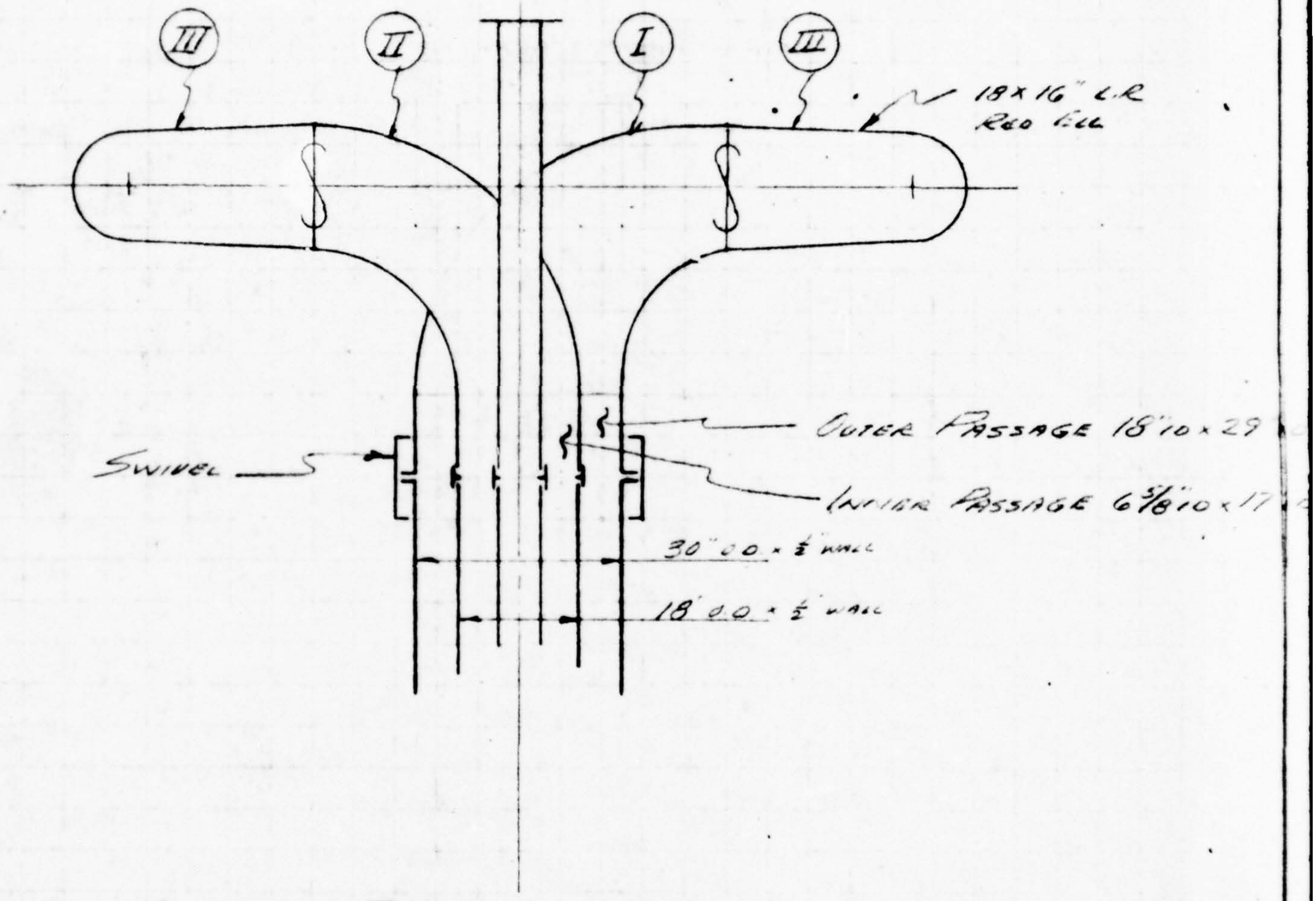
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S ARMY - ERDL	1 of

SUBJECT
MONO MOORING SYSTEM - SWIVEL LOADS

NUMBER	COMPUTER	CHECKED BY	DATE
56017	WAP		2-19-65



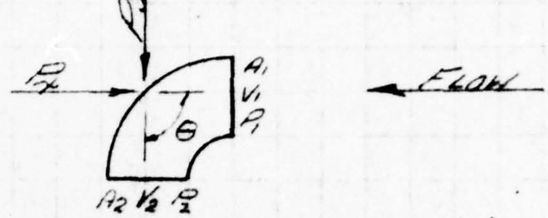
NOTES: FLOW THRU INNER & OUTER PASSAGES TO BE 10,500 GPM EACH. TOTAL 21,000 GPM (39000 BPH)

FLOW MAY BE THRU EITHER PASSAGE OR BOTH SIMULTANEOUS.

SERVICE PRESSURE RATING 150 psi @ AMBIENT TEMPERATURES

FORMULAS:

"BERNOULLI THEOREM"

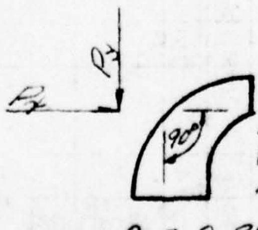


$$P_x = -\rho Q(V_2\cos\theta - V_1) + P_1A_1 - P_2A_2\cos\theta$$

$$P_y = \rho Q V_2 \sin\theta + P_2A_2\sin\theta$$

Q = FLOW cfs
ρ = DENSITY IN SLUGS PER CU FT : 1.935 for WATER
A_1 = AREA SQ FT
A_2 = " "
V_1 = VELOCITY fps
V_2 = " "
P_1 = PRESSURE LBS/SQ FT
P_2 = " "

(I).



$Q = 23.4$

$A_1 = 1.58$
$V_1 = 14.8$
$P_1 = 21,600$

$A_2 = 2.82$
$V_2 = 8.3$
$P_2 = 21,600$

(Cont'd)

8"10 x 29

5/8"10 x 17

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY - ERDL
SHEET NO: 2 of
SUBJECT: MONO MOORING SYSTEM - SWIVEL LOADS
NUMBER: J.O. 56017
COMPUTER: WAP
CHECKED BY:
DATE: 2-22-65

I contd

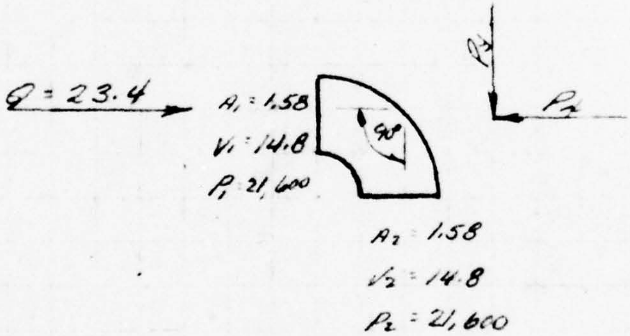
$P_x = -1.935 \times 23.4 (8.3 \cos 90 - 14.8) + 21{,}600 \times 1.58 - 21{,}600$

$P_x = 670 + 34{,}100 - 0 = \underline{34{,}770 \text{ LBS}}$

$P_y = 1.935 \times 23.4 \times 8.3 \sin 90 + 21{,}600 \times 2.82 \sin 90$

$P_y = 375 + 60{,}850 = \underline{61{,}225 \text{ LBS}}$

II



$P_x = -1.935 \times 23.4 (14.8 \cos 90 - 14.8) + 21{,}600 \times 1.58 \; 21$

$P_x = 670 + 34{,}100 - 0 = \underline{34{,}770 \text{ LBS}}$

$P_y = 1.935 \times 23.4 \times 14.8 \sin 90 + 21{,}600 \times 1.58 \sin 90$

$P_y = 670 + 34{,}100 = \underline{34{,}770 \text{ LBS}}$

s

1.58 - 21,600 x 2.82 cos 90

sin 90

x 1.58 21,600 x 1.58 cos 90

s

58 sin 90

s

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

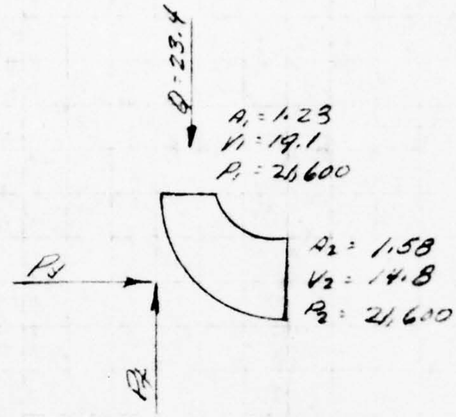
J. RAY McDERMOTT & CO., INC.

COMPANY		SHEET NO
U.S. ARMY · ERDL		3 of

SUBJECT: MONO MOORING SYSTEM - SWIVEL LOADS

NUMBER	COMPUTER	CHECKED BY	DATE
J.O. 56017	WAP		2-22-65

III



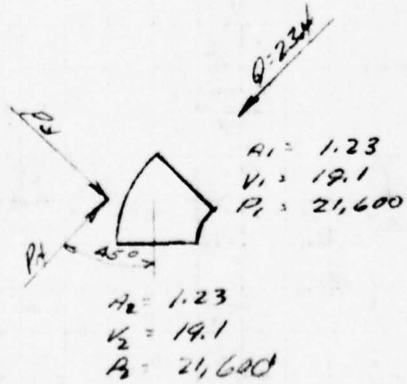
$P_x = -1.935 \times 23.4\ (14.8 \cos 90 - 19.1) + 21,600 \times 1.2$

$P_x = 865 + 26,600 - 0 = \underline{27,465 \text{ LB}}$

$P_y = 1.935 \times 23.4 \times 14.8 \sin 90 + 21,600 \times 1.58$

$P_y = 670 + 34,100 = \underline{34,770 \text{ LBS}}$

IV



$P_x = -1.935 \times 23.4\ (19.1 \cos 45 - 19.1) + 21,600 \times 1.$

$P_x = 254 + 26,600 - 18,800 = \underline{8,05}$

905

5

600 x 1.23 21,600 x 1.58 cos 90

165 LBS

x 1.58 sin 90°

LBS

,600 x 1.23 - 21,600 x 1.23 cos 45

8,054 LBS

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
U.S. ARMY - E.R.D.L.			4 of
SUBJECT			
MONO MOORING SYSTEM - SWIVEL LOADS			
NUMBER	COMPUTER	CHECKED BY	DATE
V.O. 56017	WAD		2-22-65

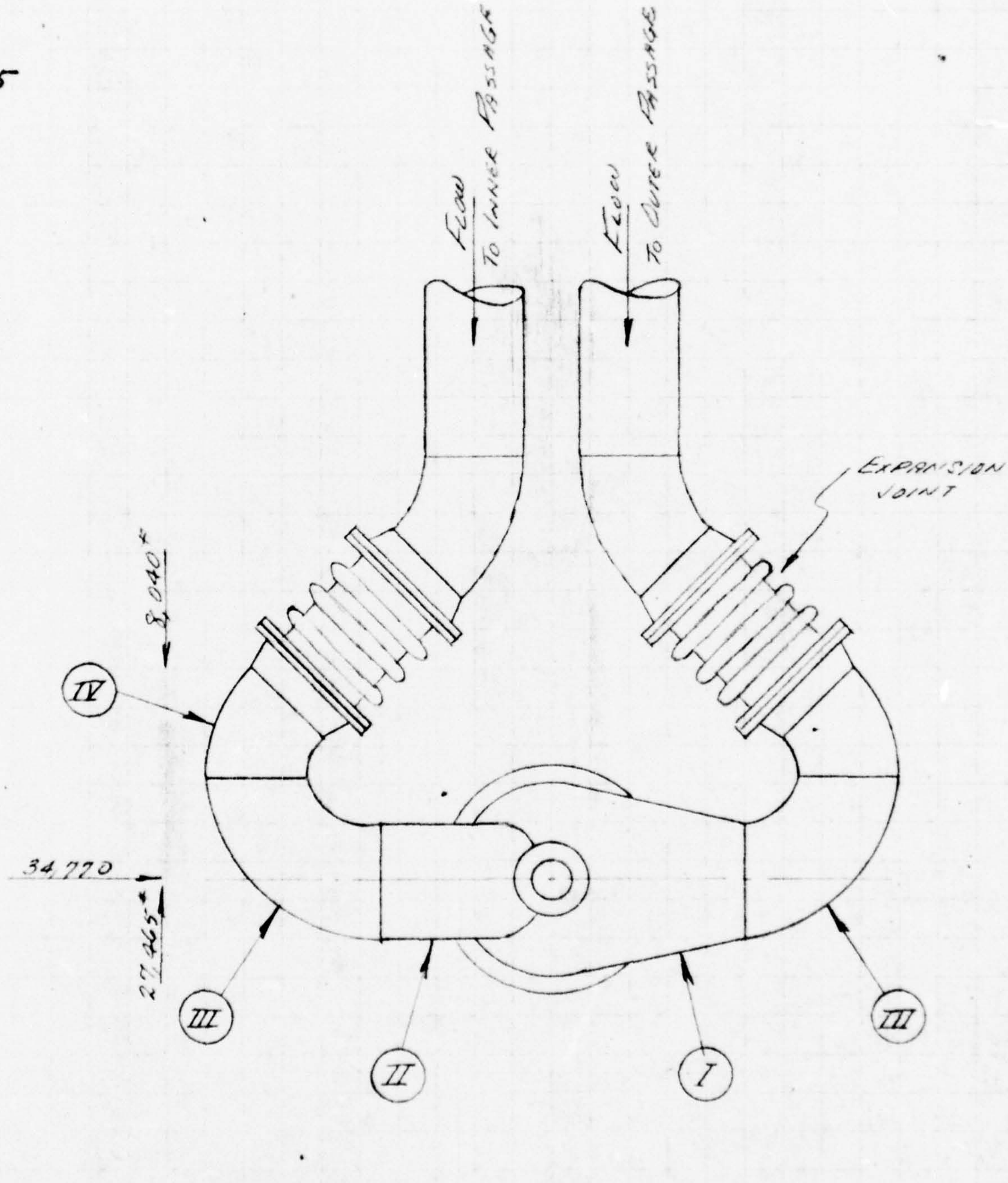
IV cont'd

$$P_y = 1.935 \times 23.4 \times 19.1 \sin 45 + 21{,}600 \times 1.$$

$$P_y = 612 + 18{,}800 = \underline{19{,}412 \text{ LBS}}$$

600 × 1.3 sin 45

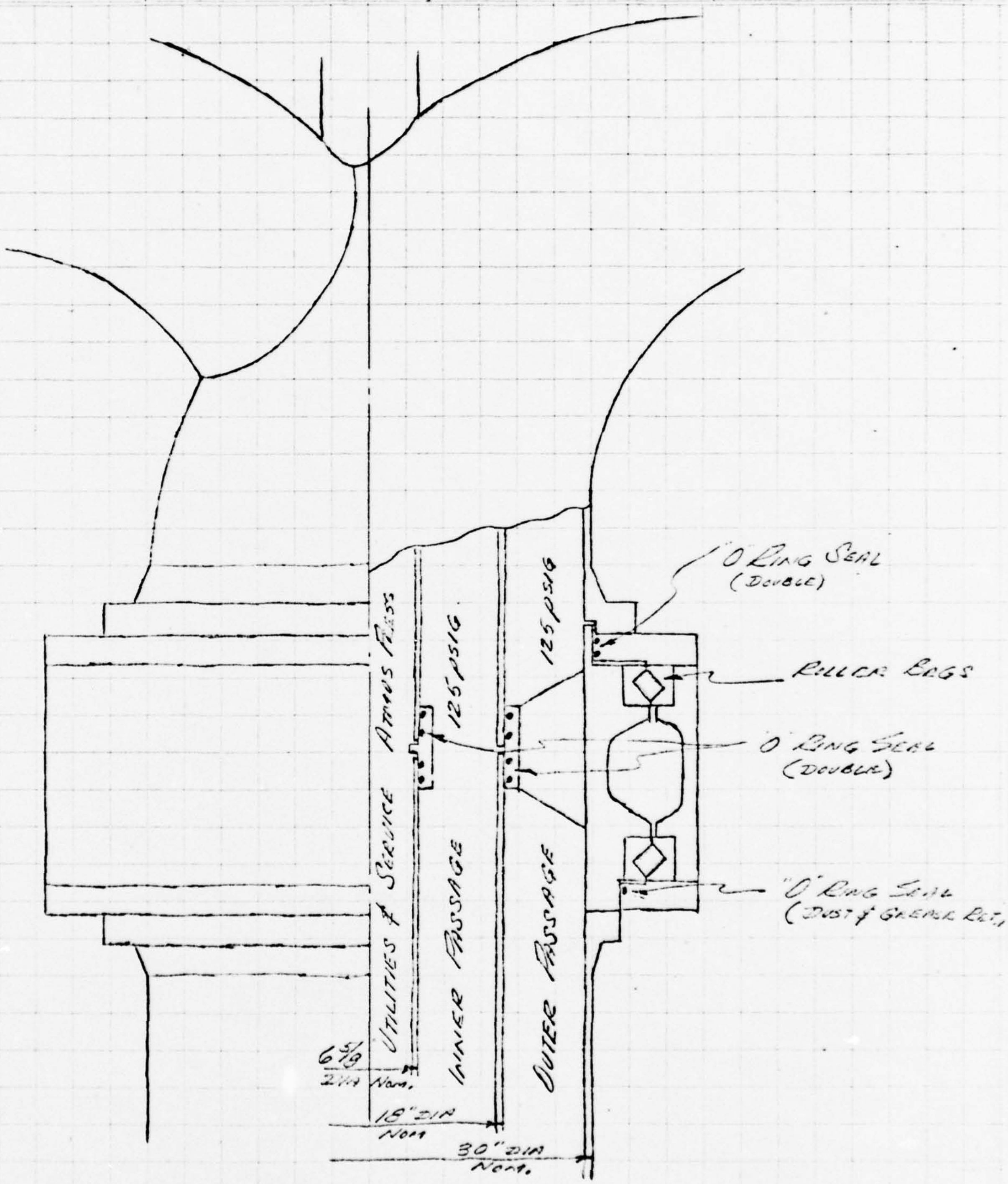
LBS



ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO JOB 56017
SUBJECT: MONO MOORING SYSTEM			
DRAWING NUMBER	COMPUTER: WAD	CHECKED BY	DATE: 2-1-65

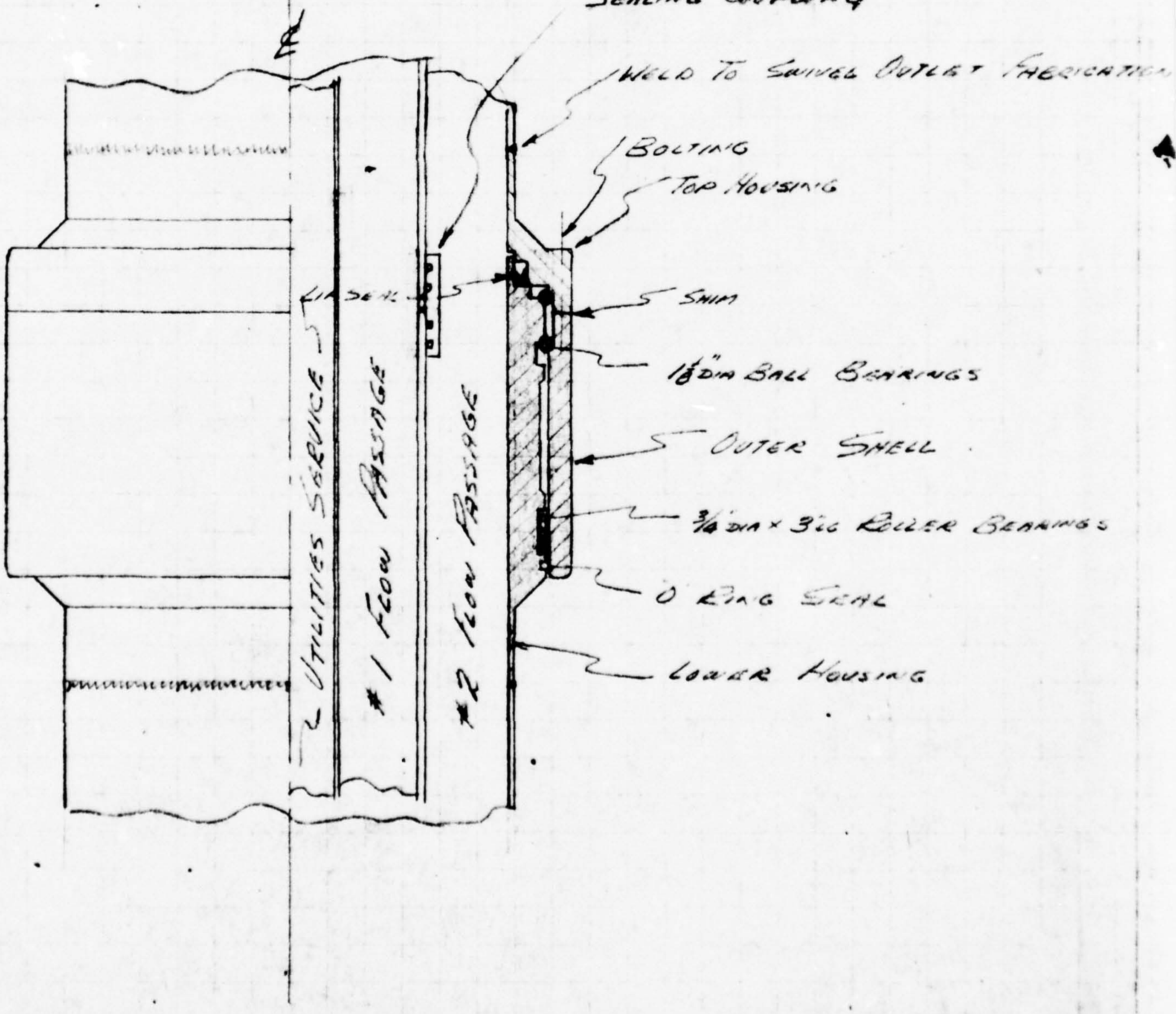


FLUID IN FLOW PASSAGES: -
AVIATION GASOLINE
JET FUEL, DIESEL OIL

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
			1 of 1
SUBJECT: Mono Mooring System - Swivel			
DRAWING NUMBER	COMPUTER: WAP	CHECKED BY	DATE: 12-23-64



FABRICATION

BEARINGS

VERTICAL LIFTING FORCE = $F(A - a)$

$F = 100$ PSI

$A = 29^2 \times .785 = 660.5$ SQ IN

$a = 6\frac{5}{8}^2 \times .785 = 34.5$ SQ IN

$F = 100\,(660.5 - 34.5) = \underline{\underline{62,600\#}}$

NEGLECTING WT OF SWIVEL OUTLET COMPONENTS

LOAD RATING FOR BALL BEARINGS : $P = .44Kd^2n$

P = PERMISSIBLE LOAD

K = CONSTANT 5-10 RPM = 20

d = DIA BALL = $1\frac{1}{8} = \frac{9}{8} = {}^{*}9$

n = NUMBER BALLS = $\frac{34 \times \pi}{1.125} = 95$

$P = .44 \times 20 \times 9^2 \times 95 = \underline{\underline{68,400\#}}$

LOAD RATING FOR ROLLER BEARING : $P = \frac{Klnd^2}{ND + 2000d}$

P = PERMISSIBLE LOAD

K = CONSTANT = 1,200,000

d = DIA ROLLER = .750"

n = NUMBER ROLLERS = 141

D = INNER RACE DIA = 33.5"

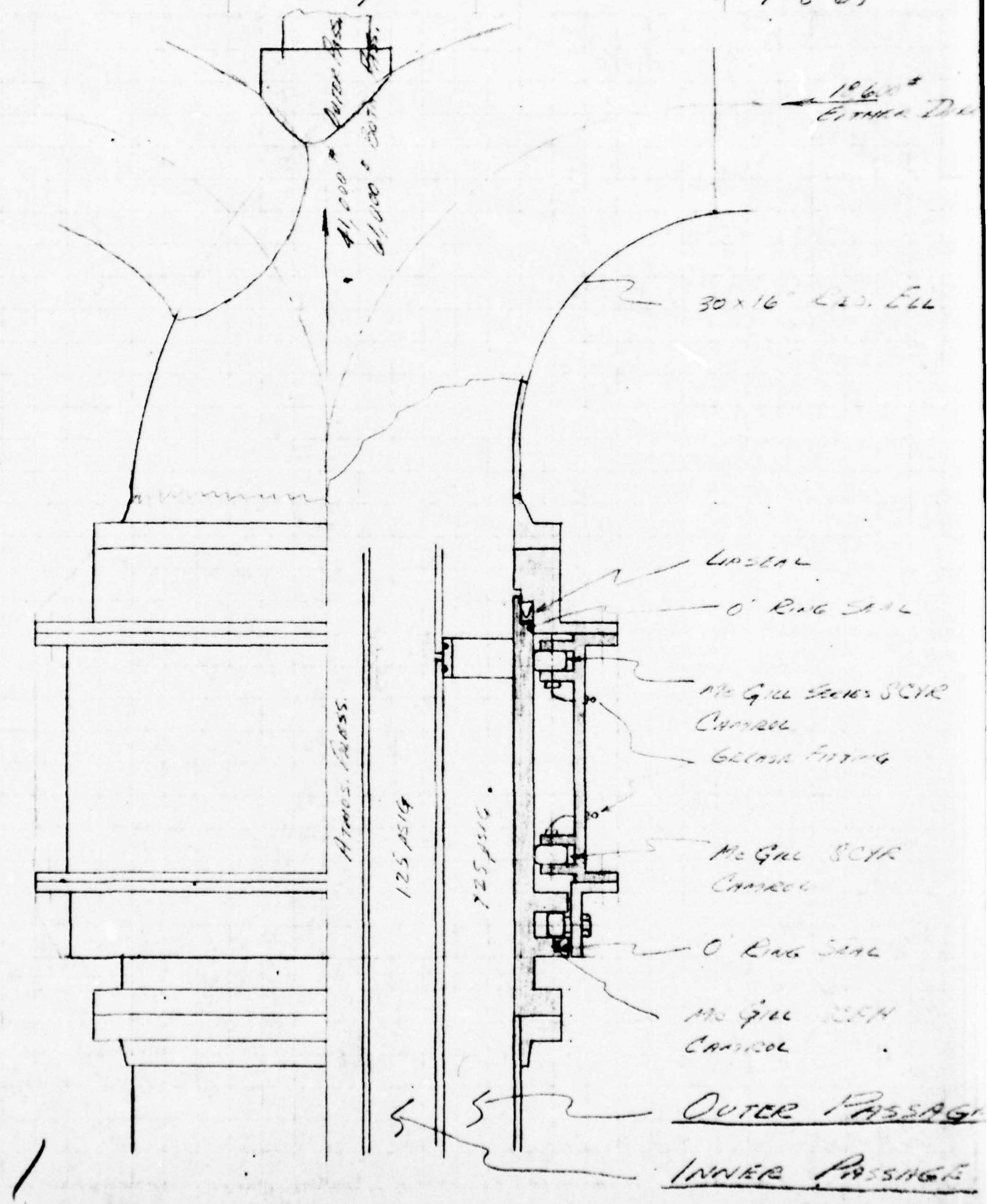
l = LENGTH OF ROLLER = 3"

$P = \frac{1,200,000 \times 3 \times 141 \times .75^2}{1 \times D + 2000 \times .75} = \underline{186,000\#}$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 2 of
SUBJECT Mono Mooring System - Preliminary Swivel			
DRAWING NUMBER	COMPUTER WAF	CHECKED BY	DATE 1-8-65



J.O. 56017

...wer Design for - 100 psi

Diagram

...ll

...yr

OPERATING CONDITIONS

for 100 psi Service

1. FLOW IN OUTER PASSAGE ONLY

VERTICAL THRUST = 41,000#
OVERHANG LOAD = 18,600# @ 45"

2. FLOW IN BOTH PASSAGES

VERTICAL THRUST = 61,000#
OVERHANG LOAD = 22,000# @ 45"

3. FLOW IN INNER PASSAGE

LOADS EQUAL OR LESS THAN
CONDITION 1.

NOTE - ROTATION TO BE
ALMOST STATIC CONDITION

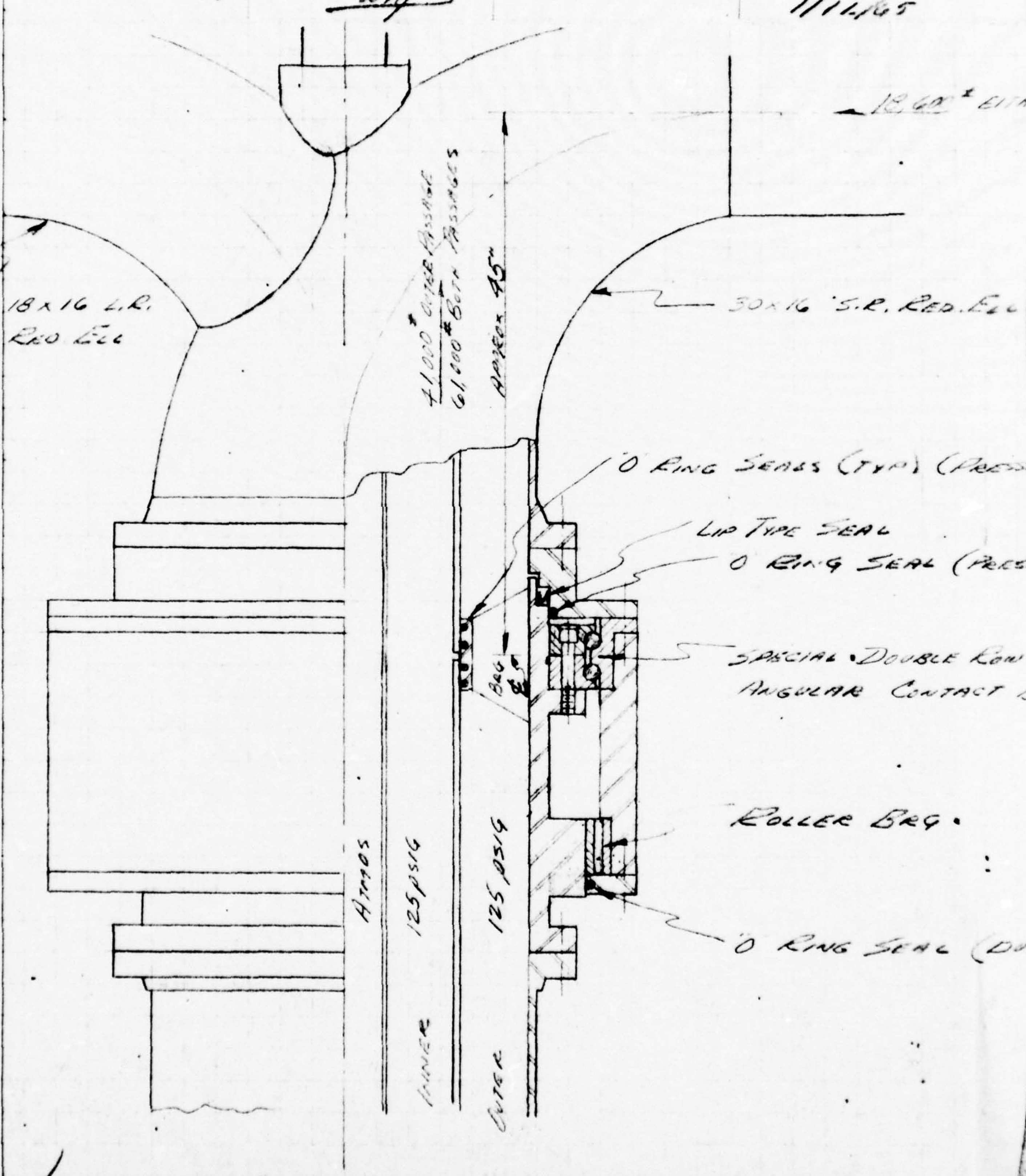
...sage

...age

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY E.R.D.L
SHEET NO: 3 of
SUBJECT: MONO MOORING SYSTEM PRELIMINARY SWIV
DRAWING NUMBER:
COMPUTER: WRF
CHECKED BY:
DATE: 1/11/65



VO 560-9

4

Swivel Design for 100psi

00± EITHER DIRECTION

RED. ELL

(PRESSURE)

(PRESSURE)

SINGLE ROW
CONTACT BALL BRG.

G.

:

(OIL & WATER)

OPERATING CONDITIONS
for 100psi SERVICE

1. FLOW IN OUTER PASSAGE ONLY

VERTICAL THRUST 41,000#
OVER HUNG LOAD 18,600# @ 45"

2 FLOW IN BOTH PASSAGES

VERTICAL THRUST 61,000#
OVER HUNG LOAD : 22,000# @ 45"

3 FLOW IN INNER PASSAGE ONLY

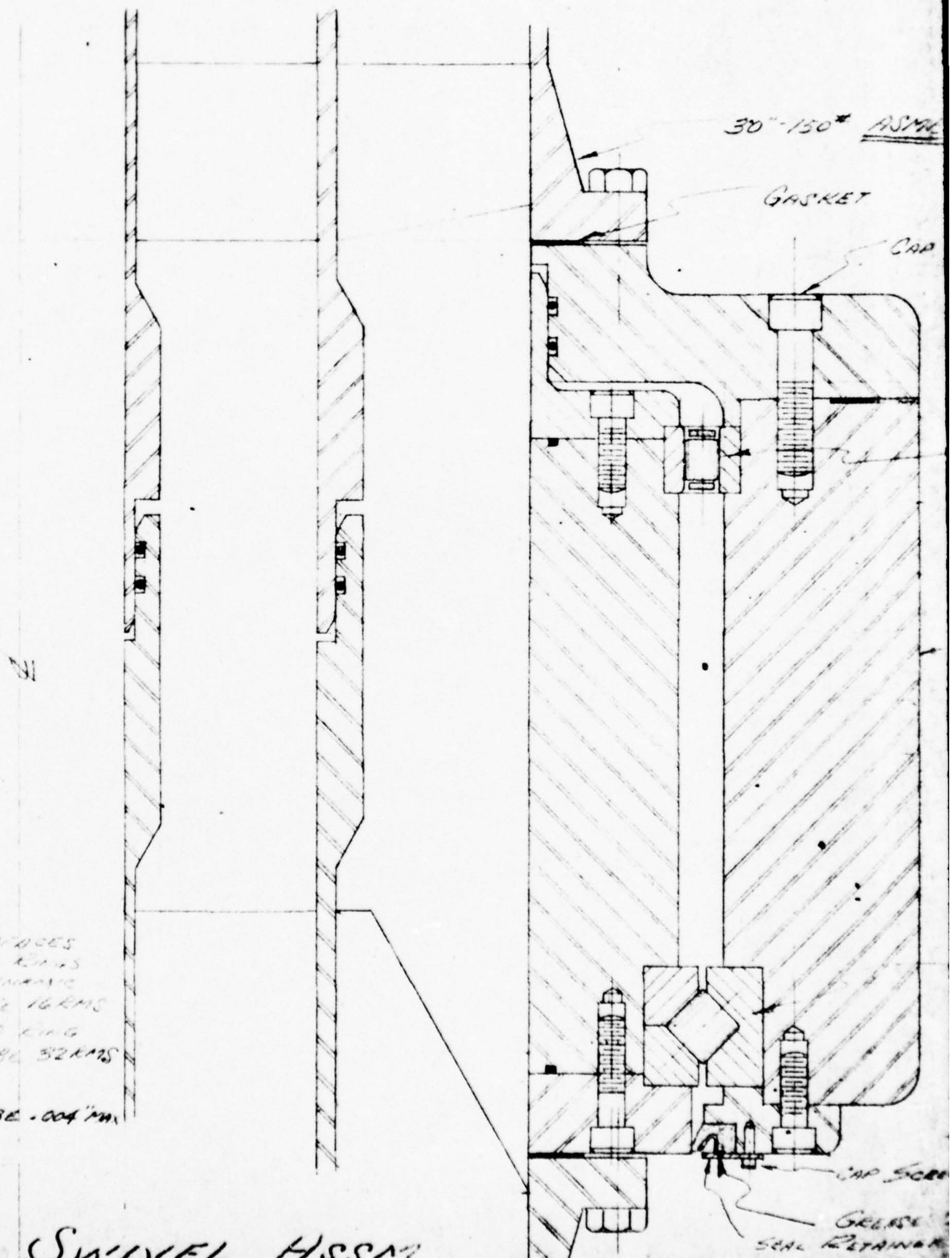
USE FIGURES FOR CONDITION 1.

NOTE: ROTATION TO BE
ALMOST STATIC CONDITION

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY - EROL			SHEET NO
SUBJECT: MONO MOORING SYSTEM - SWIVEL DESIGN for 150			
NUMBER: J.O. 56017	COMPUTER: WAD	CHECKED BY	DATE: 3-31-65



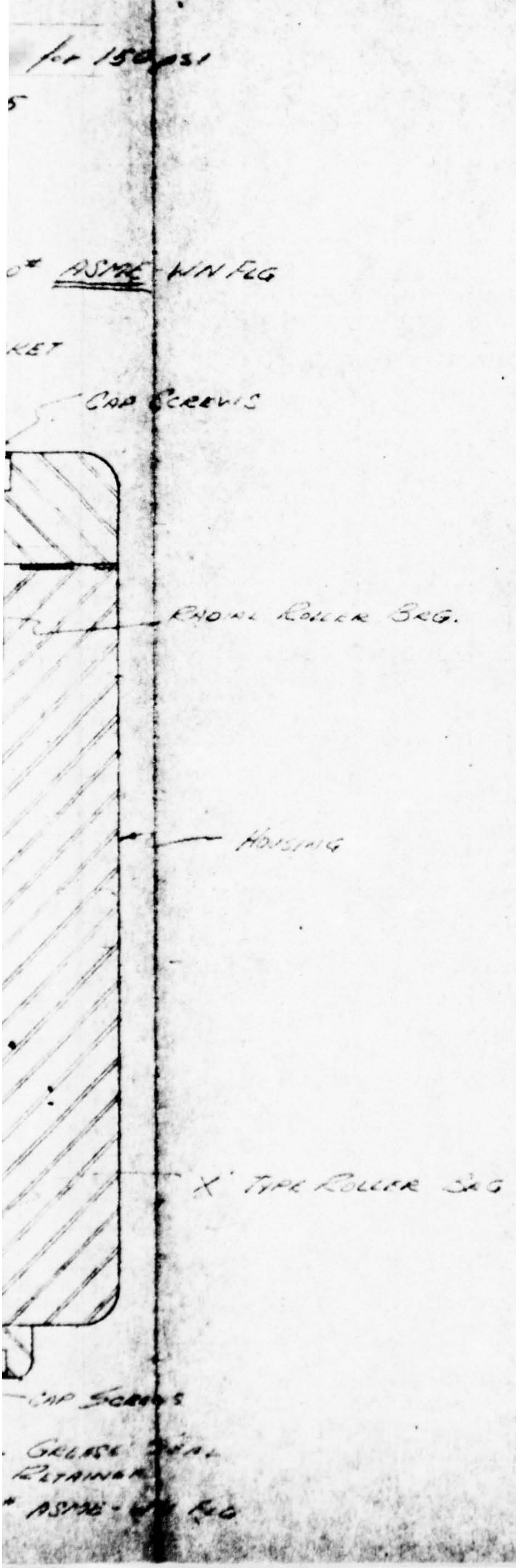
NOTE: —

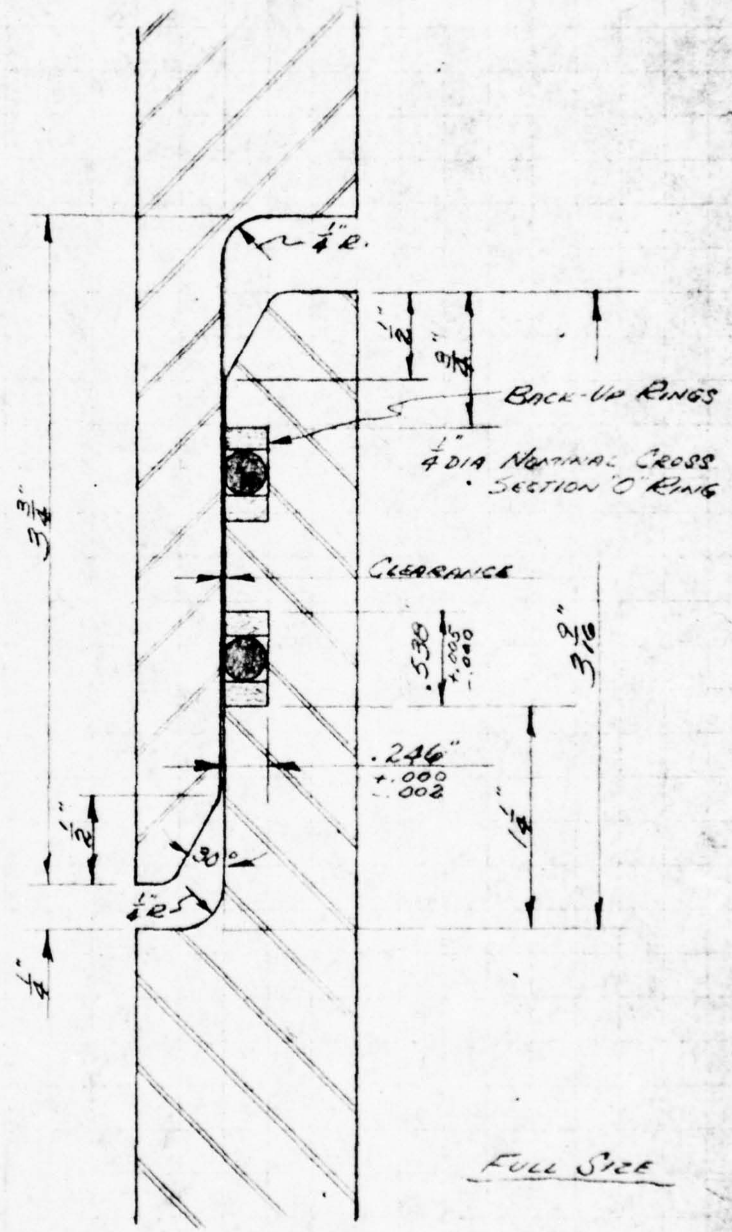
1. ALL SURFACES WHICH O RINGS FORM DYNAMIC SEAL TO BE 16 RMS
2. STATIC O RING SEAL TO BE 32 RMS
3. TIR TO BE .004" MAX

SWIVEL HSSM

1/4 SIZE

1



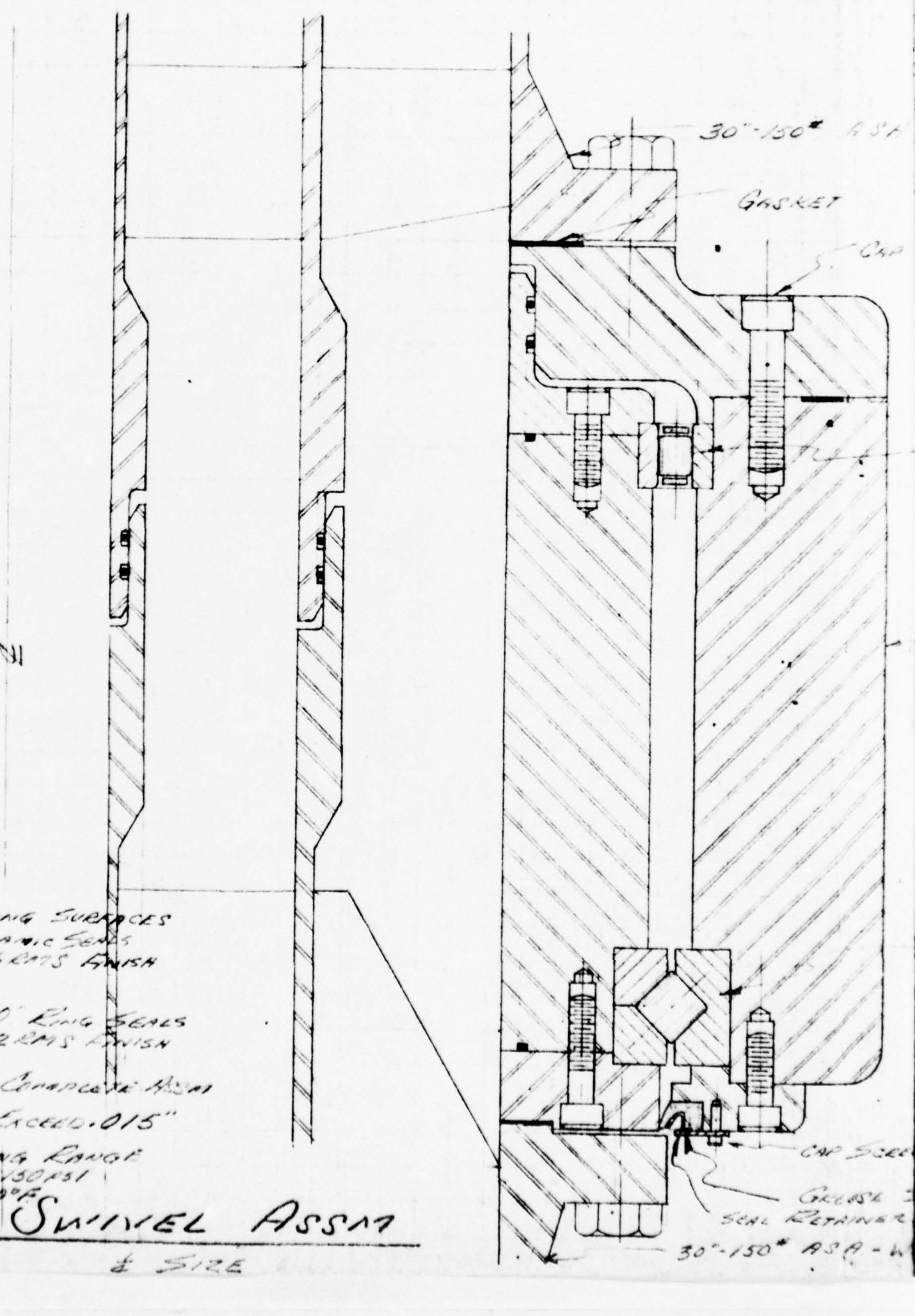


TYPICAL SEAL ASSM.

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S ARMY - EROL
SHEET NO
SUBJECT: MONO MOORING SYSTEM - SWIVEL DESIGN FOR 15
NUMBER: J.O 56017
COMPUTER: WAD
CHECKED BY
DATE: 4-23-65

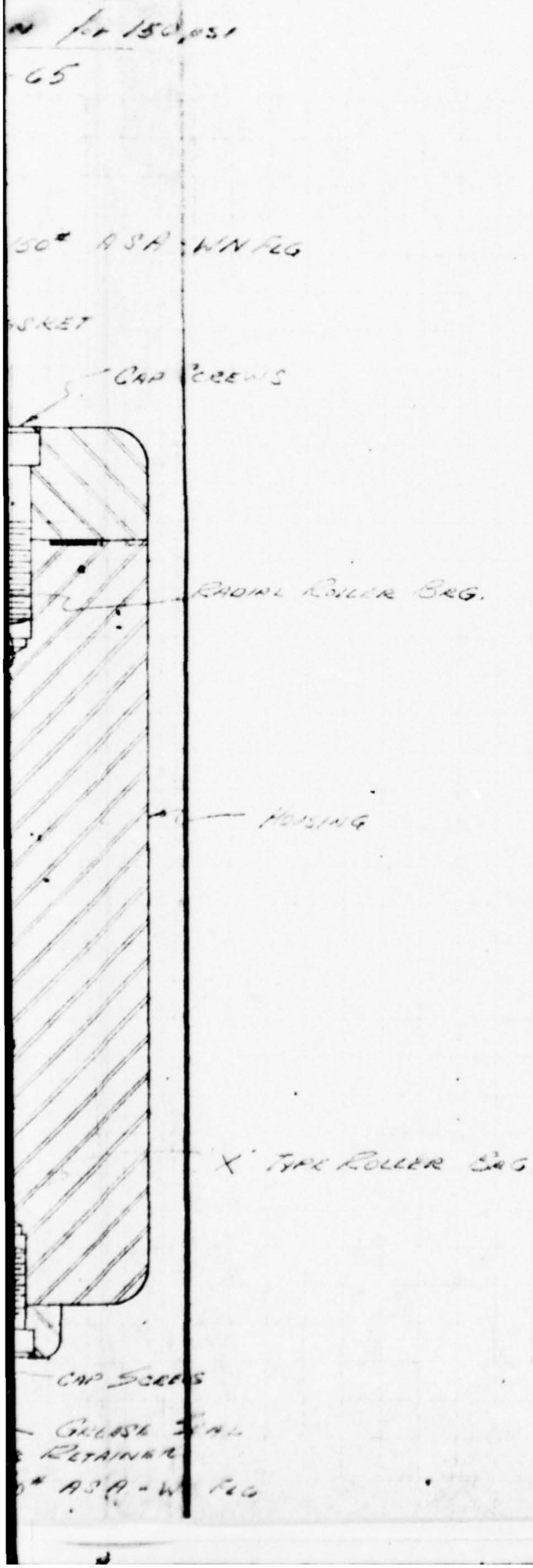


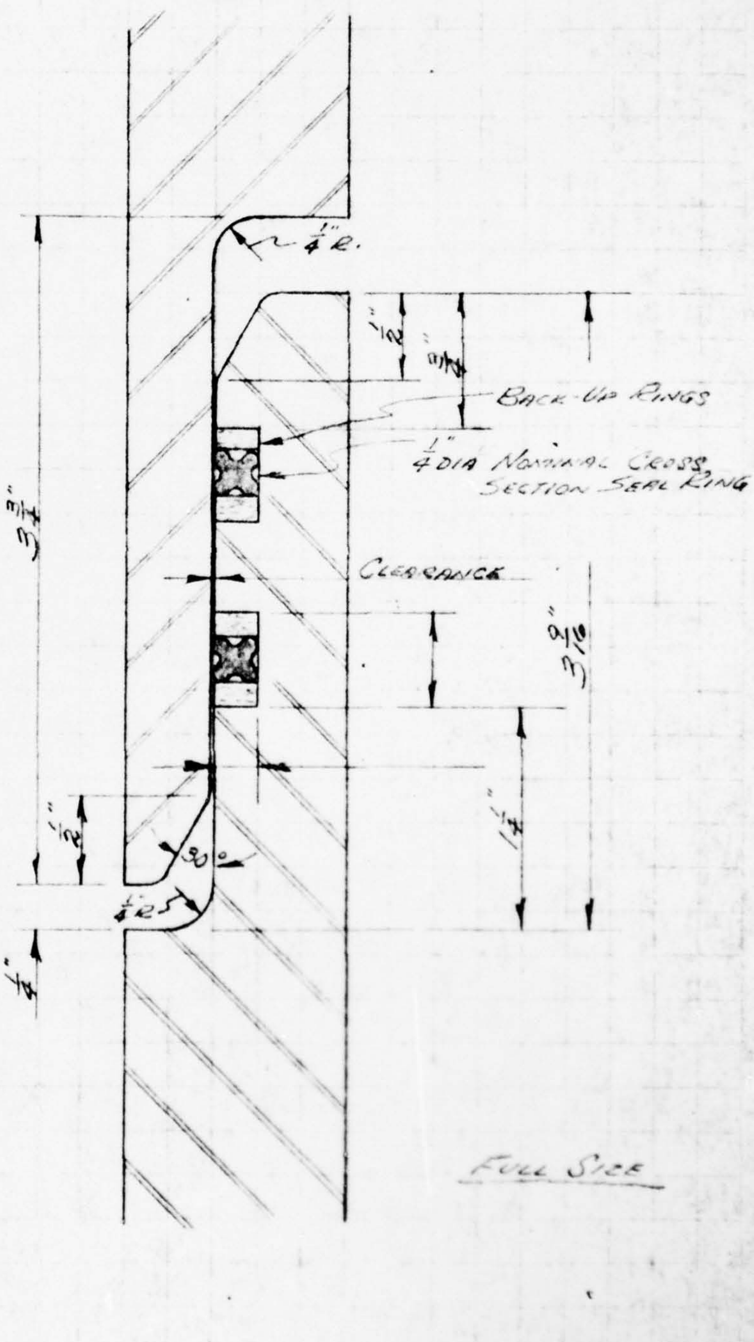
NOTES -

1. ALL SEALING SURFACES WITH DYNAMIC SEALS TO BE 16 RMS FINISH
2. STATIC "O" RING SEALS TO BE 32 RMS FINISH
3. T.I.R. OF COMPLETE ASSM NOT TO EXCEED .015"
4. OPERATING RANGE 30 to 150 PSI 20 to 120°F

SWIVEL ASSM

½ SIZE





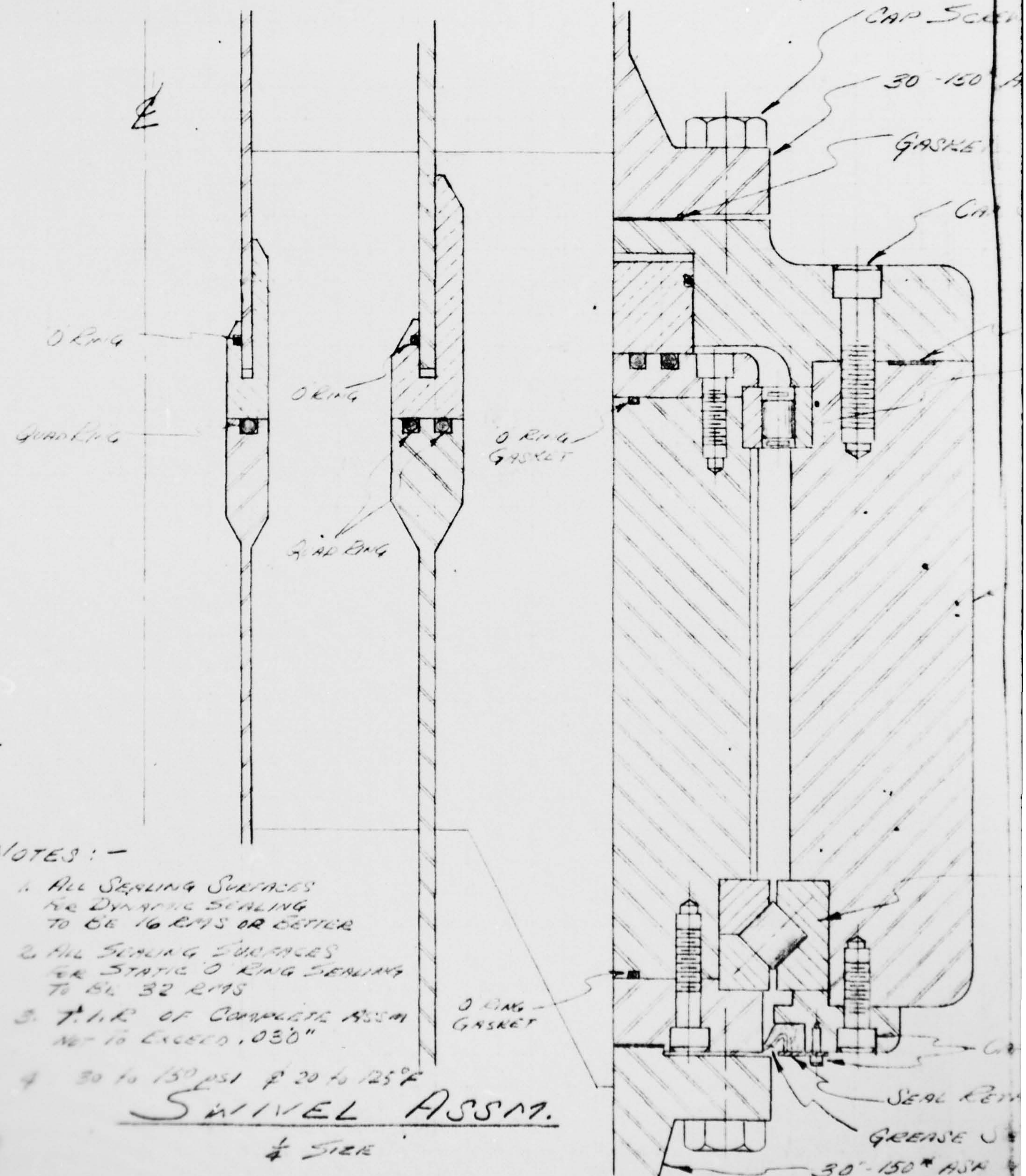
TYPICAL SEAL ASSM.

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
U.S. ARMY - ERDL			
SUBJECT: MONO MOORING SYSTEM - SWIVEL DESIGN			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
	WAP		4/23/65

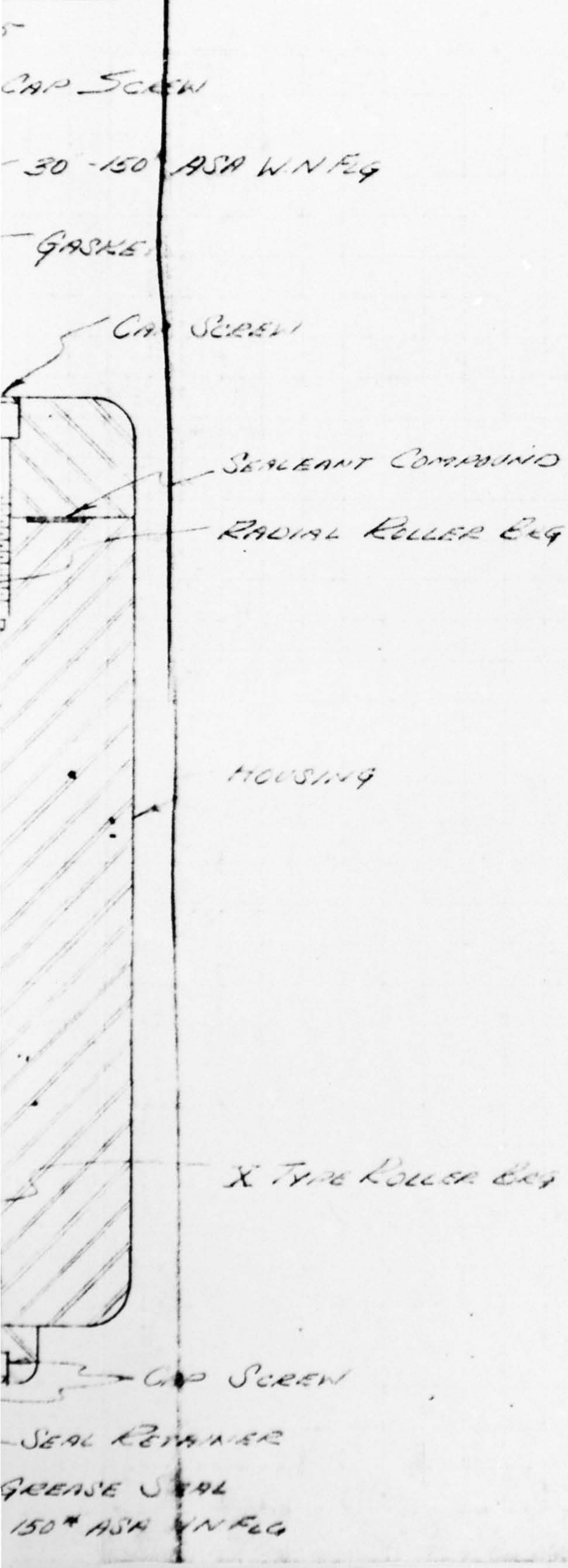


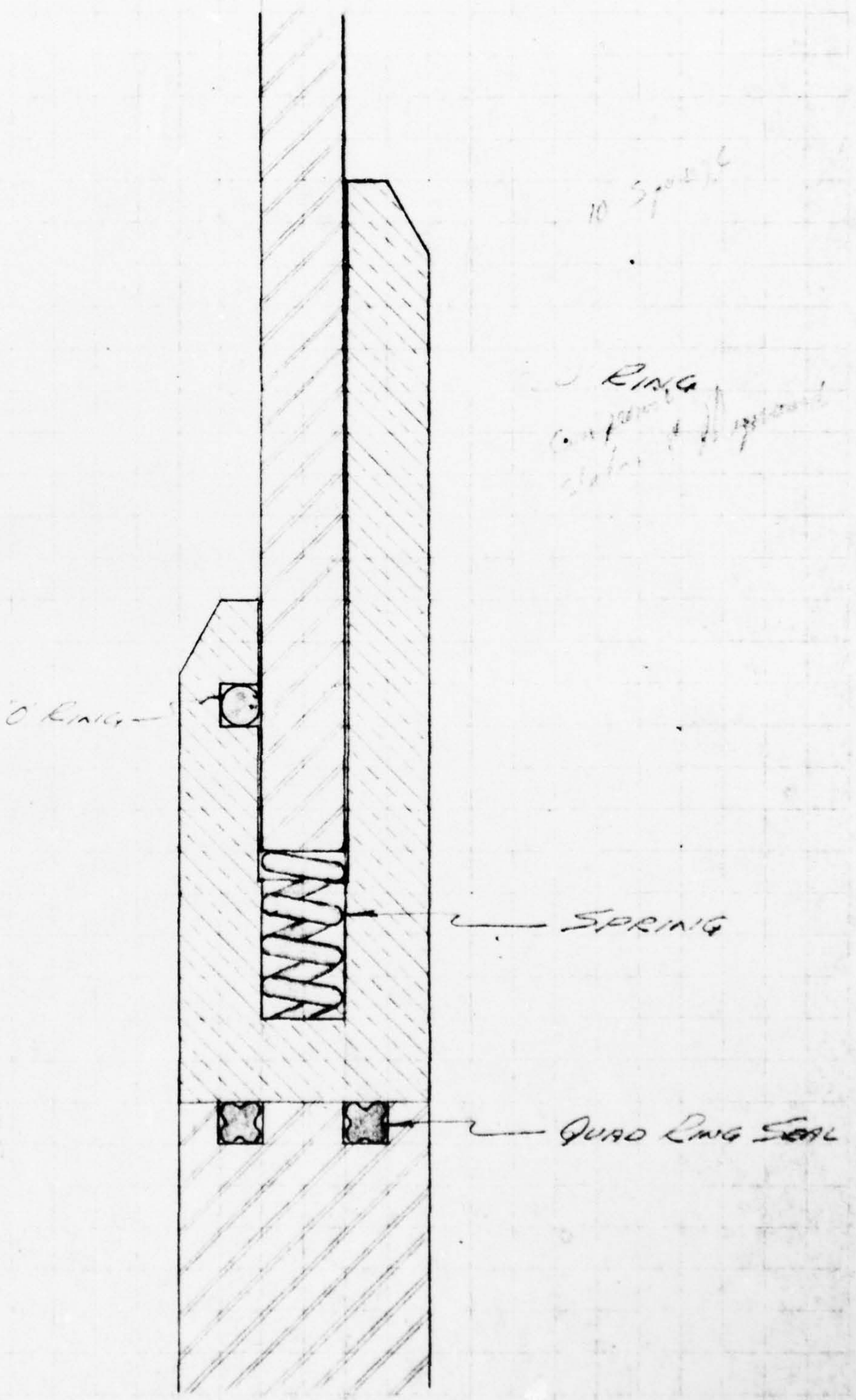
NOTES:-

1. ALL SEALING SURFACES FOR DYNAMIC SEALING TO BE 16 RMS OR BETTER
2. ALL SEALING SURFACES FOR STATIC O RING SEALING TO BE 32 RMS
3. T.I.R. OF COMPLETE ASSM NOT TO EXCEED .030"
4. 30 to 150 psi @ 20 to 125°F

SWIVEL ASSM.

1/4 SIZE





TYPICAL SEAL ASSM.

FULL SIZE

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

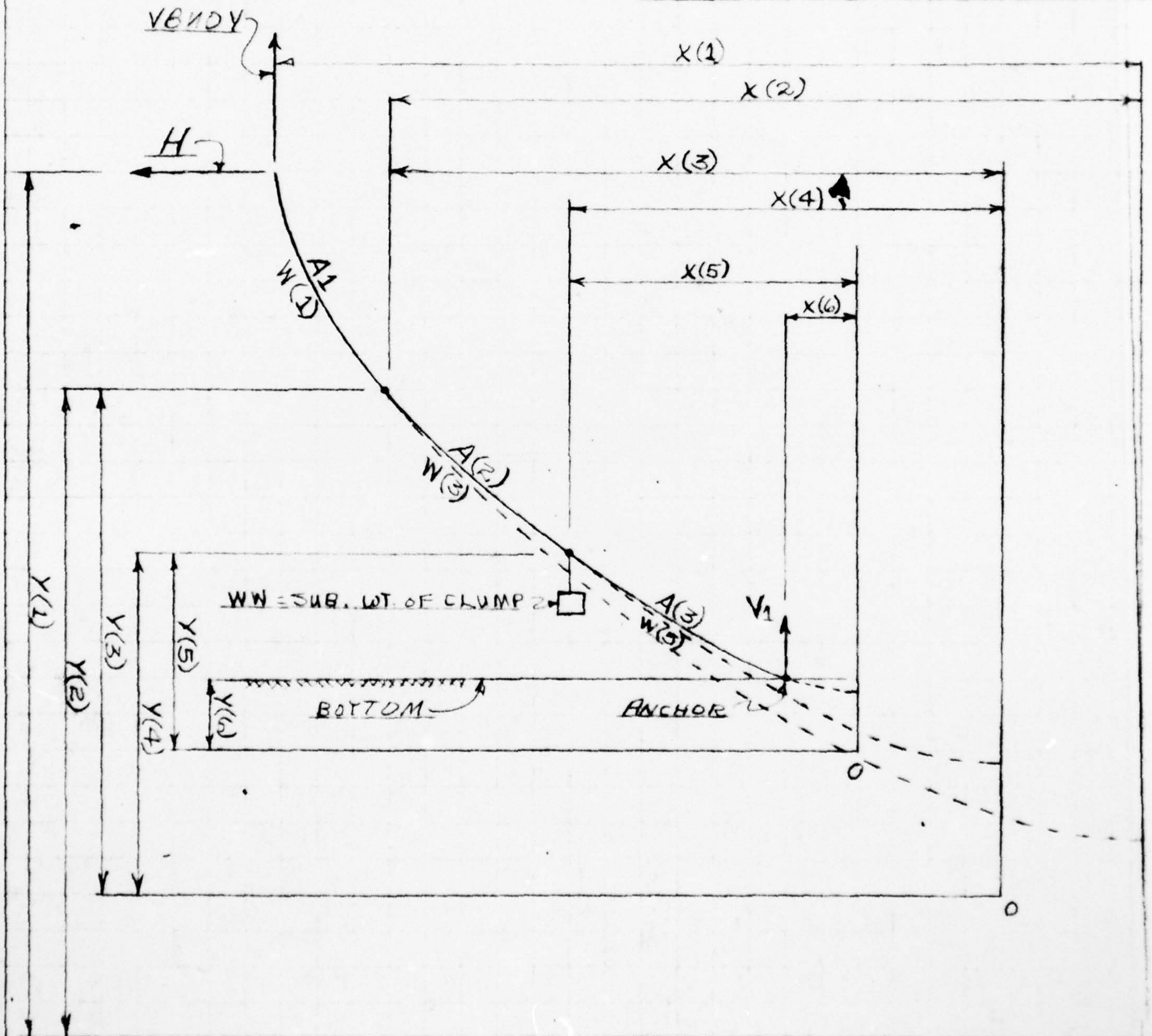
J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO
U.S. ARMY/EROL	1

SUBJECT: MONO-MOORING SYSTEM - SAMPE CALCULATIONS

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JOB 56017	ANDREWS		11-4-65

EXPLANATION OF VARIABL



NOTE: IF SENSE SWITCH 2 IS "OFF", NONE OF THE "T", "X" OR "Y" VALUES WILL BE PRINTED OUT.

ANCHOR LEG CALCULATIONS

VARIABLES FOR COMPUTER PROGRAM

ADDITIONAL INPUT

VPCC = WATER DEPTH (VERTICAL PROJECTION FROM H TO BOTTOM)
DELTA = INCREMENT TO VARY H BY
TOL = ALLOWABLE TOLERANCE FOR VPCC
M = CONTROL VARIABLE 1 OR 2 TO BE USED TO DESIGNATE CONDITION AT ANCHOR.

1 - SIGNIFIES NO VERTICAL REACTION AT ANCHOR
2 - SIGNIFIES VERTICAL REACTION AT ANCHOR TO BE CONSIDERED.

OUTPUT

T(1) = TENSION @ BUOY (TOP OF A1)
T(2) = TENSION @ BOTTOM OF A1
T(3) = TENSION @ TOP OF A2
T(4) = TENSION @ BOTTOM OF A2
T(5) = TENSION @ TOP OF A3
T(6) = TENSION @ BOTTOM OF A3 (AT ANCHOR)

X(1), X(2), X(3), X(4), X(5), & X(6) = HORIZONTAL PROJECTIONS FROM ORIGIN TO CORRESPONDING "T" POINTS.

Y(1), Y(2), Y(3), Y(4), Y(5) & Y(6) = VERTICAL PROJECTIONS FROM ORIGIN TO CORRESPONDING "T" POINTS.

H = HORIZONTAL COMPONENT THROUGHOUT CATENARY
VBUOY = VERTICAL COMPONENT OF CATENARY @ BUOY
CHP = HORIZONTAL PROJECTION OF CATENARY FROM ANCHOR TO BUOY
DX = CHANGE IN HORIZONTAL PROJECTION (CHP).
V1 = VERTICAL COMPONENT OF CATENARY @ ANCHOR.

THREE ELEMENT CATENARY *SH. 2*

```
      DIMENSION C(6),S(6),T(6),U(6),W(6),X(6),Y(6)
    1 PRINT 5100
      PRINT 5000
      IF (SENSE SWITCH 2)  112,114
  114 PRINT 5001
  112 K=0
      CHPL=0.0
      A1L=0.0
      A2L=0.0
      B2L=0.0
      V1 =0.0
      N=1
      DO 2 I=1,6
      X(I)= 0.0
      Y(I)= 0.0
    2 S(I)= 0.0
      READ 3, H,DELTA,VPCC,WW,W(1),TOL
      READ44, W(3),W(5),A1,A2,A3,M
    3 FORMAT (F8.2,F8.2,F8.2,F8.2,F8.2,F8.2)
   44 FORMAT (5F8.2,I4)
      CON = DELTA
      W(2)= W(1)
      W(4)= W(3)
      W(6)= W(5)
    9 S(6)= V1/ W(6)
      S(5)= S(6)+ A1L
      S(4)= S(5)+ B2L
      S(3)= S(4)+ A2L
      S(2)= (S(3)*W(3))/ W(2)
      S(1)= S(2) + A1
   10 DO 4 I=1,6
      C(I)= H/ W(I)
    4 Y(I)= SQRT(S(I)**2 + C(I)**2)
      CVP = (Y(1)+Y(3)+Y(5)) - (Y(2)+Y(4)+Y(6))
        TEST= CVP-VPCC
      IF(CVP-VPCC)11,12,13
   11 IF(TEST+TOL)111,12,12
  111 H= H- CON
      CON= CON/ 10.0
      GO TO 10
   13 IF (TEST-TOL)12,12,113
  113 H= H+ CON
      GO TO 10
   12 CON= DELTA
      DO 5 I=1,6
      U(I)= Y(I)/ C(I)
      IF(U(I)-1.0)17,18,18
   17 U(I)= 1.0
   18 X(I)= LOG(U(I)+(SQRT(U(I)**2-1.0))) * C(I)
    5 T(I)= Y(I) * W(I)
      VBUOY=SQRT(T(1)**2-H**2)
```

```
      SUM= A2+A3-A1L-A2L
      CHP = (X(1)+X(3)+X(5)) - (X(2)+X(4)+X(6)) + SUM
      DX=CHP-CHPL
      IF(SENSE SWITCH 2)51,50
   51 PRINT 5200
      PRINT 5021
      DO 6 I=1,6
    6 PRINT 5022,T(I),X(I),Y(I)
      PRINT 5200
      PRINT 5001
   50 PRINT 5002,H,VBUOY,CHP,DX,V1
      CHPL=CHP
      GO TO (60,200,80,90),N
   60 IF(K-10)61,69,69
   61 A2L= A2L + (A2/ 10.0)
      K=K+1
      GO TO 9
   69 K=0
  200 IF(WW)201,201,70
  201 B2L=0.
      N=3
      GO TO 9
   70 IF(K-10)71,79,79
   71 B2L= B2L + (WW/ (W(4)*10.0))
      K=K+1
      N=2
      GO TO 9
   79 K=0
   80 IF(K-10)81,89,89
   81 A1L=A1L+(A3/10.0)
      K=K+1
      N=3
      GO TO 9
   89 K=0
  300 IF(M-1)99,99,90
   90 IF(K-10)91,99,99
   91 V1= V1 + (H/ 100.0)
      K=K+1
      N=4
      GO TO 9
   99 GO TO 1
 5000 FORMAT (23HXTHREE ELEMENT CATENARY)
 5001 FORMAT(10X,1HH,5X,5HVBUOY,9X,3HCHP,10X,2HDX,6X,2HV1)
 5002 FORMAT (1X,2F10.2,2F12.4,F8.2)
 5021 FORMAT (18X,1HT,17X,1HX,17X,1HY)
 5022 FORMAT (1X,3E18.8)
 5100 FORMAT (1H1)
 5200 FORMAT (1H )
      END
```

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY/ERDL
SHEET NO: 4

SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS

DRAWING NUMBER: JOB 55017 | COMPUTER: ANDREWS | CHECKED BY: | DATE: 10-27-65

SAMPLE FOR 100 FOOT WATER DEPTH

DETERMINE INPUT FOR NORMAL W.D. = 100'

MSL = 100'   WT. OF BUOY = 145 Tons

VERTICAL REACTION FROM PRELOAD ≈ 126^K

WEIGHT OF FOAM = 29^K

DETERMINE APPROXIMATE DRAFT UNDER PRELOAD

TOTAL VERTICAL ≈ 290 + 126 + 29 = 445^K
BUOYANCY FROM SKIRT AND RUBBER BUMPERS ≈ 41^K

REVISED TOTAL WT. = 445 - 41 = 404^K

BUOYANCY/FT. FOR BUOY = 41.6^K

APPROXIMATE DRAFT UNDER PRELOAD = $\frac{404}{41.6}$ = 9.7'

VERTICAL PROJECTION OF CATENARY
VPCC = 100 - (9.7 - 7) = 97.3'

ADDITIONAL COMPUTER INPUT FOR 3"ϕ CHAIN

H = 0.   DELTA = 3.   VPCC = 96.3   WW = 0.   W(1) = .0784   TOL = .1

W(3) = .0784   W(5) = .0784   A1 = 100.   A2 = 500.   A3 = 500.   M = 1

SUBMERGED WT OF CHAIN IN SEAWATER = DRY WT/FT x 0.8693
SUBMERGED WT OF CHAIN IN FRESHWATER = DRY WT/FT x 0.8725

ANCHOR LEG CALCULATIONS

TER DEPTH (MSL) ______

DETERMINE INPUT FOR 100' W.D. (MAX. CONDITIONS)

MAX. W.D. = 100 + 10 + 20(.67) = 123.4'   BUOY WT. = 145T

VERTICAL UNDER MOORING LOAD ≈ 200^k

WT. OF FOAM = 29^k

DETERMINE APPROX. MAX. DRAFT UNDER MOORING LOAD

TOTAL VERTICAL = 290 + 200 + 29 - 41 = 478^k

$DRAFT = \frac{478}{41.6} = 11.5'$

VERTICAL PROJECTION OF CATENARY

VPCC = 123.4 - (11.5 - 7) = 118.9'

COMPUTER INPUT

N = 0. DELTA = 3.0 VPCC = 118.9 WW = 0. W(1) = .0784 TOL = .1

W(3) = .0784 W(4) = .0784 A1 = 120. A2 = 500. A3 = 500. M = 1

L = .1

1

INPUT SPECIFICATIONS
MCD 12504

J. RAY McDERMOTT & CO., INC.
COMPUTER PROGRAM DOCUMENTATION

DATE	PROGRAM NO	USER GROUP NUMBER	SHEET	OF
10-27-65	CATNRY		5	

TITLE: SAMPLE DATA FOR THREE ELEMENT CATENARY

1–8	9–16	17–24	25–32	33–40	41–48
0.	3.	97.3	0.	.07764	.1
.07764	.0784	100.	500.	500.	1

1–8	9–16	17–24	25–32	33–40	41–48
0.	3.	118.9	0.	.07764	.1
.07769	.07764	120.	500.	500.	1

SUBMITTED BY: ANDREWS
PUNCHED BY: ANDREWS
VERIFIED BY:

100' NORMAL W.D.

SHEET 6

THREE ELEMENT CATENARY

H	VBUOY	CHP	DX	V1
.30	7.83	1015.1405	1015.1405	0.00
5.37	11.75	1054.5119	39.3714	0.00
12.51	15.67	1067.5091	12.9972	0.00
21.66	19.59	1074.4792	6.9701	0.00
32.82	23.51	1078.9070	4.4278	0.00
46.05	27.43	1082.0339	3.1269	0.00
61.35	31.35	1084.3590	2.3251	0.00
78.57	35.27	1086.1056	1.7466	0.00
98.07	39.19	1087.5609	1.4553	0.00
119.37	43.11	1088.6907	1.1298	0.00
142.77	47.03	1089.6422	.9515	0.00
142.77	47.03	1089.6422	0.0000	0.00
168.27	50.95	1090.4524	.8102	0.00
195.57	54.87	1091.1234	.6710	0.00
224.97	58.79	1091.7122	.5888	0.00
256.47	62.71	1092.2326	.5204	0.00
290.07	66.63	1092.6936	.4610	0.00
326.07	70.55	1093.1176	.4240	0.00
363.27	74.47	1093.4648	.3472	0.00
402.87	78.39	1093.7916	.3268	0.00
444.87	82.31	1094.0942	.3026	0.00
488.37	86.23	1094.3576	.2634	0.00

J. RAY MC DERMOTT CO., INC. ENGINEERS AND GENERAL CONTRACTORS NEW ORLEANS, LA.

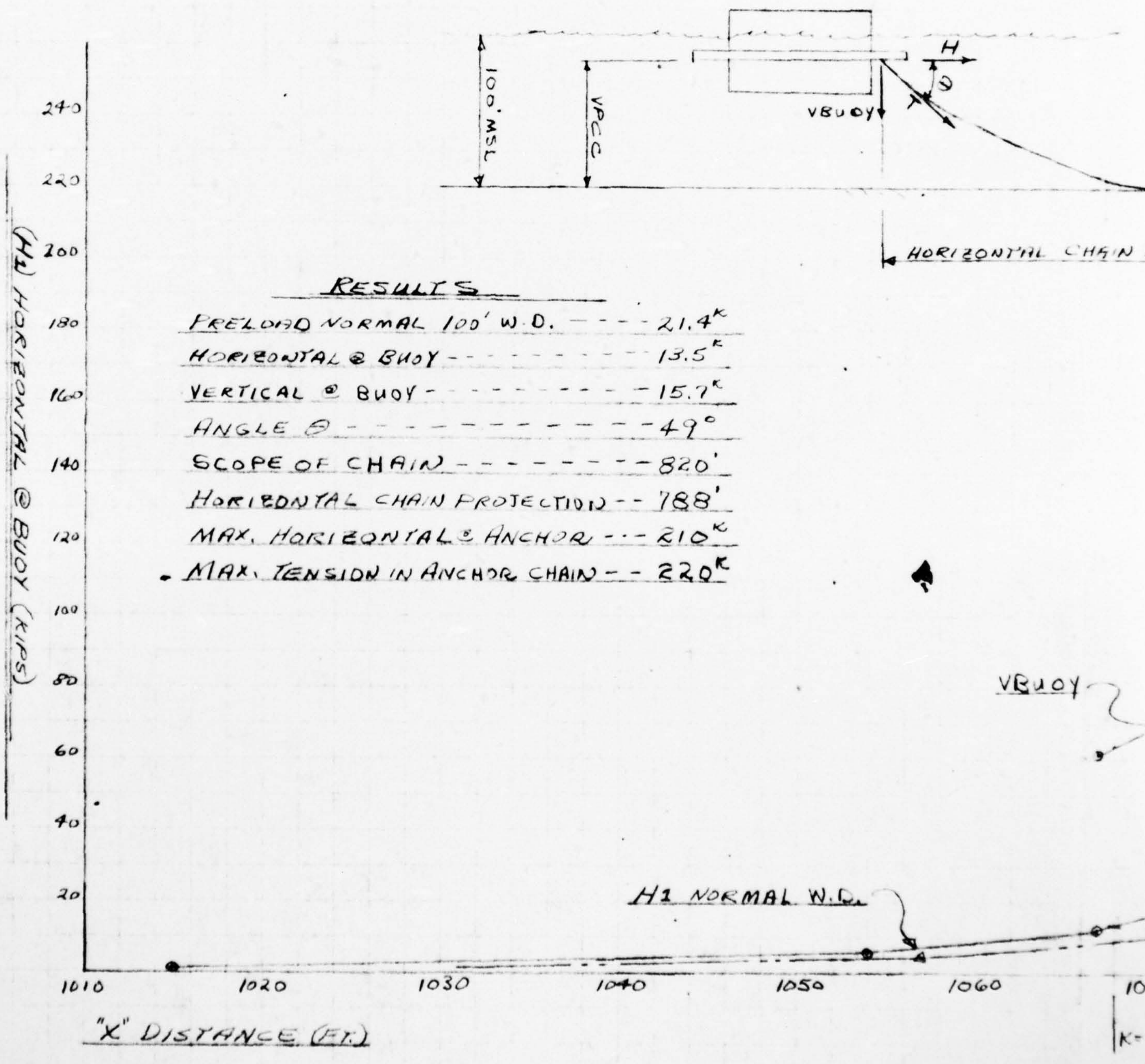
100' W.D. (MAX. CONDITIONS)

SHEET 7

THREE ELEMENT CATENARY

H	VBUOY	CHP	DX	V1
.09	9.40	1006.1331	1006.1331	0.00
4.86	13.32	1057.4700	51.3369	0.00
11.28	17.24	1074.2048	16.7348	0.00
19.38	21.16	1083.6304	9.4256	0.00
29.07	25.08	1089.6343	6.0039	0.00
40.47	29.00	1093.9728	4.3385	0.00
53.46	32.92	1097.1604	3.1876	0.00
68.16	36.84	1099.6792	2.5188	0.00
84.42	40.76	1101.6546	1.9754	0.00
102.42	44.68	1103.3077	1.6531	0.00
121.98	48.60	1104.6633	1.3556	0.00
121.98	48.60	1104.6633	0.0000	0.00
143.28	52.52	1105.8320	1.1687	0.00
166.38	56.44	1106.8564	1.0244	0.00
190.68	60.36	1107.6835	.8271	0.00
217.08	64.28	1108.4626	.7791	0.00
244.68	68.20	1109.1080	.6454	0.00
274.38	72.12	1109.7183	.6103	0.00
305.28	76.04	1110.2364	.5181	0.00
338.28	79.96	1110.7290	.4926	0.00
372.48	83.88	1111.1529	.4239	0.00
408.78	87.80	1111.5593	.4064	0.00

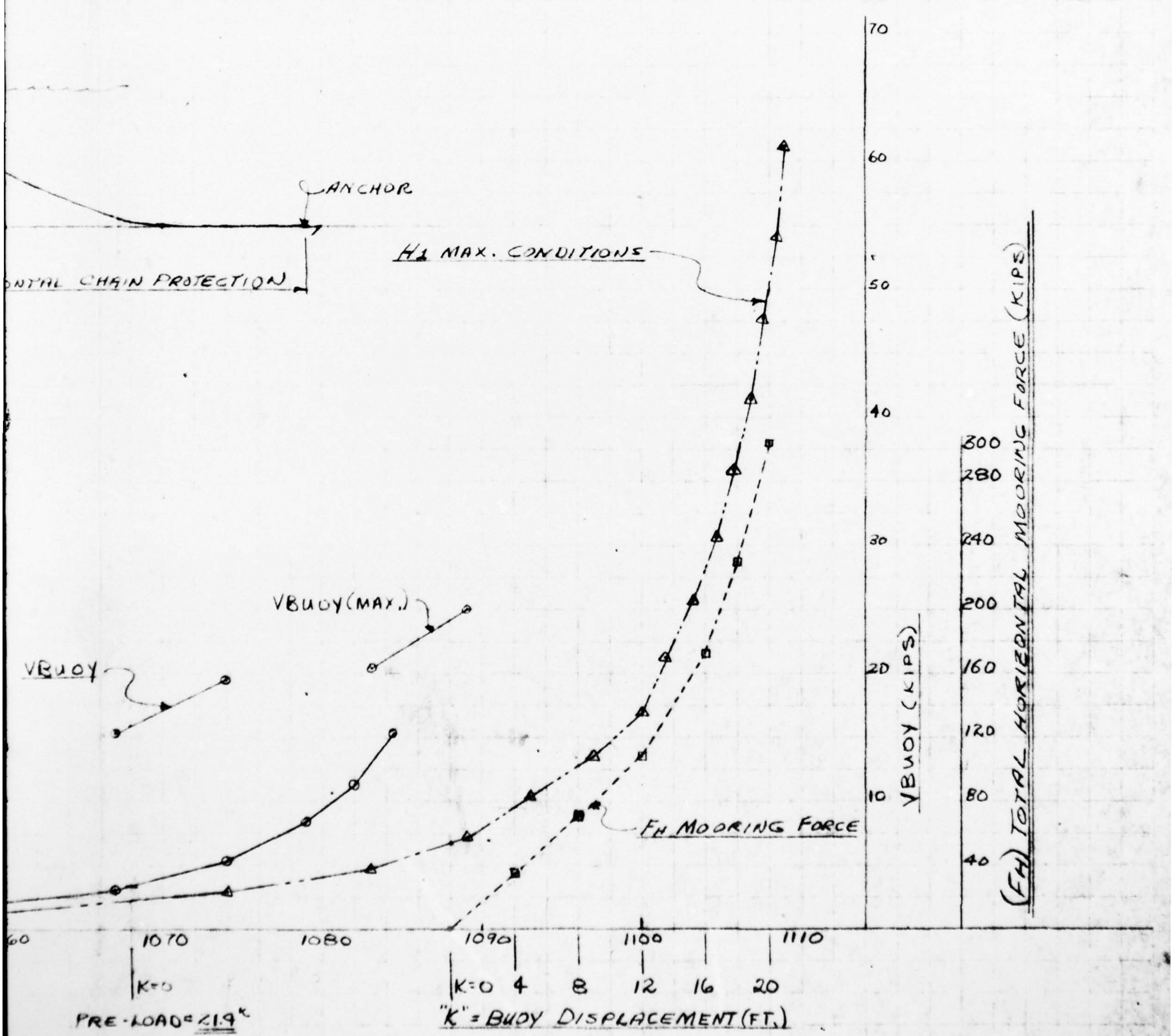
COMPANY: U.S. ARMY / ERDL	SHEET NO. 8
SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS	
DRAWING NUMBER: JOB 56017 · COMPUTER: ANDREWS · CHECKED BY:	DATE: 10-28-65



RESULTS

- PRELOAD NORMAL 100' W.D. - - - - 21.4K
- HORIZONTAL @ BUOY - - - - - - - - - - 13.5K
- VERTICAL @ BUOY - - - - - - - - - - 15.7K
- ANGLE θ - - - - - - - - - - - - - - 49°
- SCOPE OF CHAIN - - - - - - - - - 820'
- HORIZONTAL CHAIN PROJECTION - - 788'
- MAX. HORIZONTAL @ ANCHOR - - - 210K
- MAX. TENSION IN ANCHOR CHAIN - - 220K

CURVES DEVELOPED FROM COMPUTER RESULTS



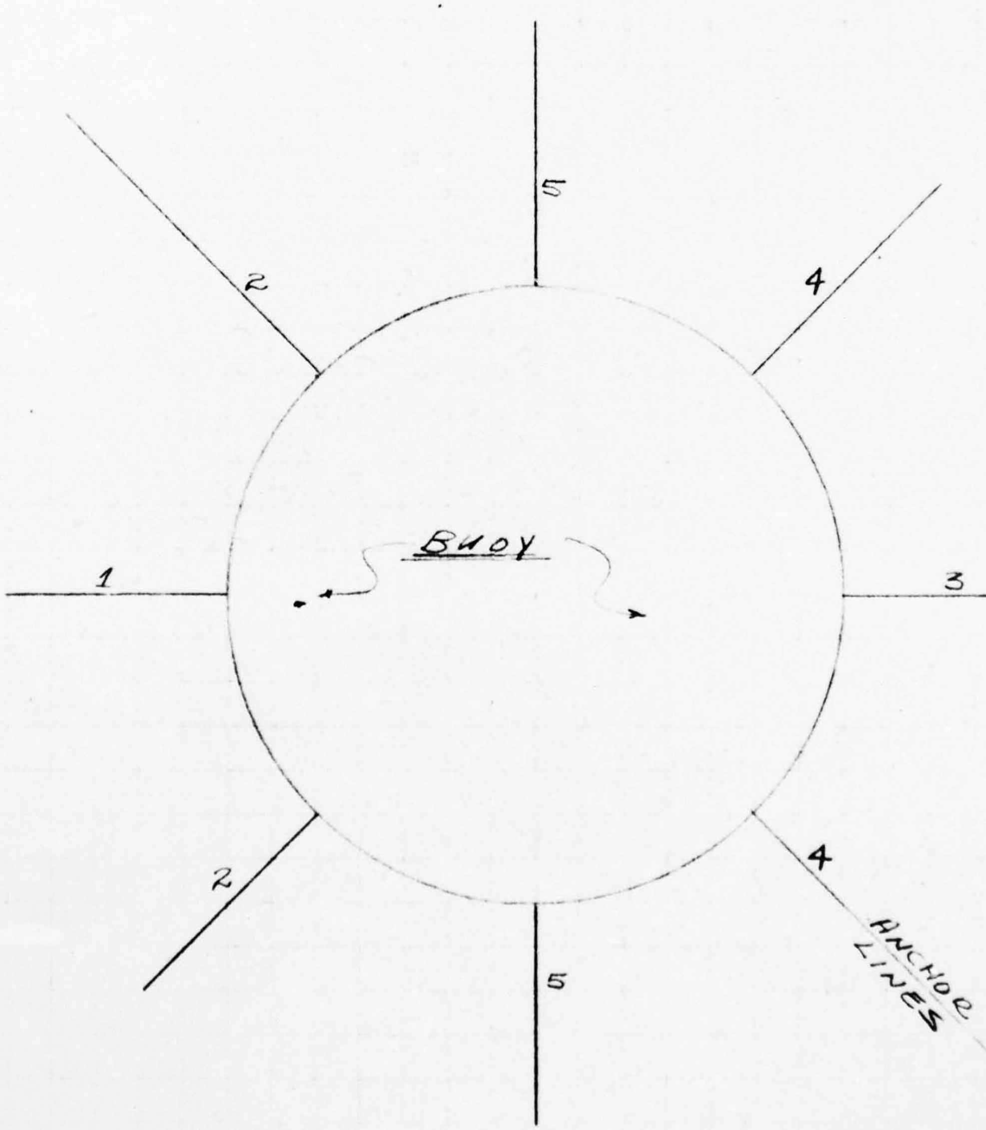
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY	SHEET NO.
U. S. ARMY / ERDL	9

SUBJECT: MONO - MOORING SYSTEM - SAMPLE CALCULATIONS

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JOB 56017	ANDREWS		10-27-65



NOTE: HEEL IS CALCULATED BY S[illegible]
MOMENTS ABOUT "K".

AD-A034 243 MCDERMOTT (J RAY) CO INC NEW ORLEANS LA F/G 13/10
ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM. VOLUME 2. --ETC(U)
1966 DA-44-009-AMC-841(T)
UNCLASSIFIED NL

2 OF 2
AD
A034243

END
DATE
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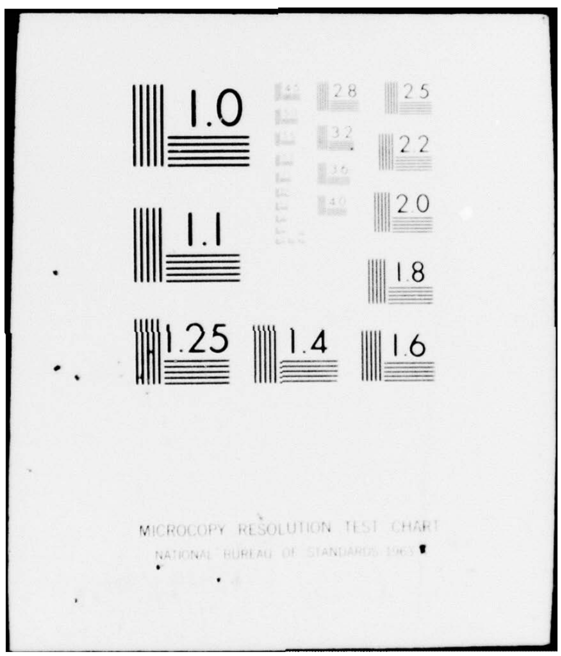
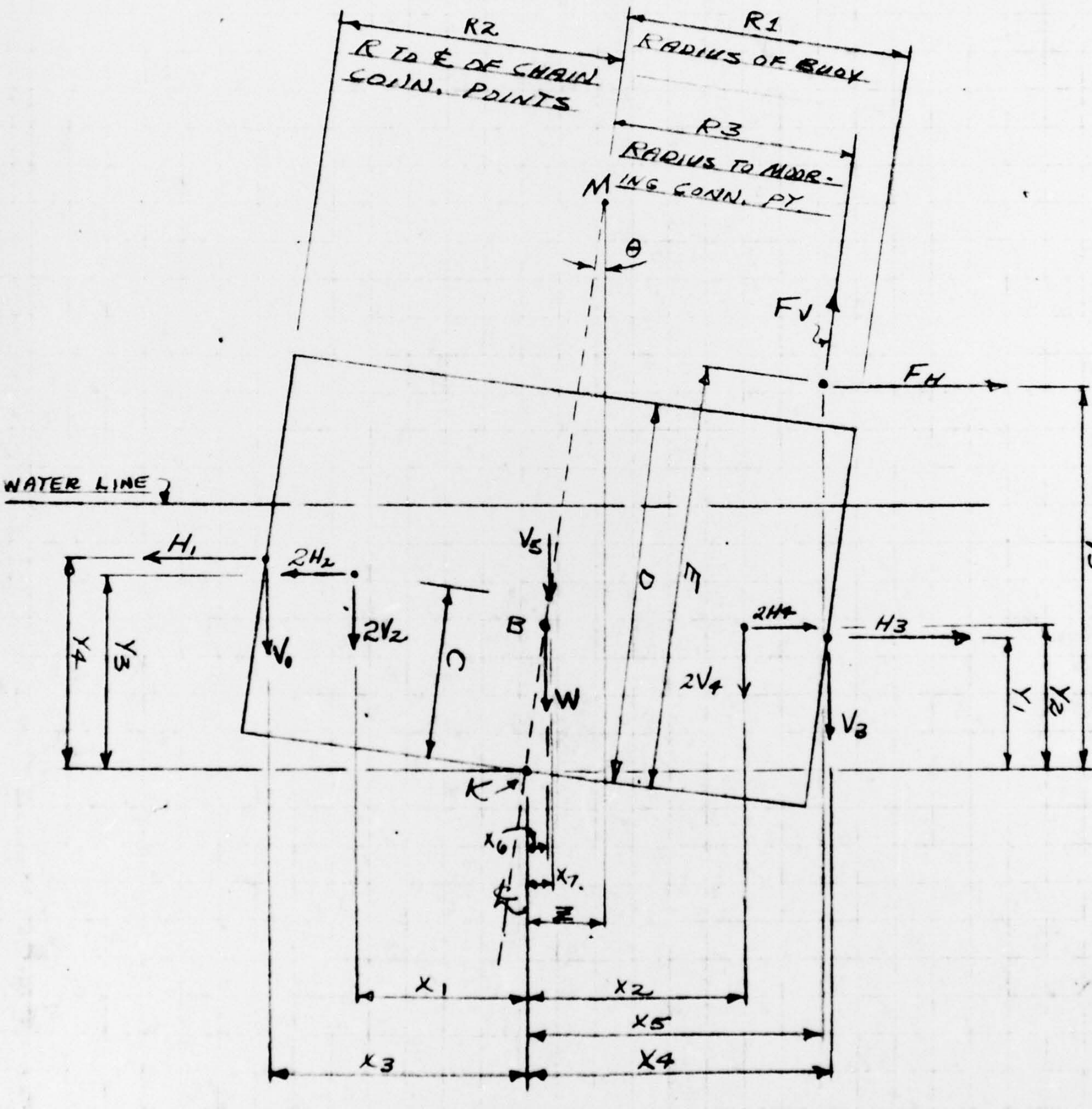
2-77


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963

HEEL ANGLE OF BUOY



FREE BODY DIAGRAM OF BUOY

BY SWIMMING

2.

J. RAY MC DERMOTT CO., INC. ENGINEERS AND GENERAL CONTRACTORS NEW ORLEANS, LA.

BUOY HEEL ANGLE

SHEET 10

```
10 READ 1,R1,R2,R3,W,C,D,E,BK
   IF(R1)20,30,20
20 READ 1,FH,H1,H2,H3,H4
   READ 1,FV,V1,V2,V3,V4,V5,WL
 1 FORMAT (F10.4,F10.4,F10.4,F10.4,F10.4,F10.4,F10.4,F10.4)
   B=V1+2.*V2+2.*V4+V3+2.*V5+W-FV
   TOP1 = (FH*E+H3*C+2.*H4*C+V3*R2+1.414*V4*R2)
   TOP2 = (-FV*R3-H1*C-2.*H2*C-V1*R2-1.414*V2*R2)
   BOT1 = (FH*R3+H3*R2+1.414*H4*R2-V3*C-2.*V4*C-2.*V5*C-W*BK+FV*E)
   BOT2 = (H1*R2+1.414*H2*R2-V1*C-2.*V2*C+WL*.7854*R1**4+B*BK)
100 TANA =(TOP1+TOP2)/(BOT1+BOT2)
200 DEG = 180.*ATANF(TANA)/3.14
   PRINT 4,B,DEG
 4 FORMAT (10X,3HB =,F10.4,10X,5HDEG =,F10.6)
   GO TO 10
30 PAUSE
   END
```

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U.S. ARMY/EROL
SHEET NO: 11
SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS
NUMBER: JOB 56017
COMPUTER: ANDREWS
CHECKED BY:
DATE: 10-28-65

DEFINITION OF VARIABLES

R1 = RADIUS OF BUOY
R2 = RADIUS TO ℄ OF PENDANT CONN. PT.
R3 = RADIUS TO MOORING LINE CONN. PT.
W = WEIGHT OF BUOY
C = DISTANCE FROM PT. "K" TO PENDANT CONN. PT.
D = DEPTH OF BUOY
E = DISTANCE FROM PT. "K" TO MOORING LINE CONN. PT.
BK = DISTANCE FROM PT. "K" TO POINT OF BUOYANCY
FH = HORIZONTAL COMPONENT FROM MOORING LINE
H1 = HORIZONTAL @ BUOY FROM CORRESPONDING PENDANT.
H2 = HORIZONTAL @ BUOY FROM #2 PENDANTS
H3 = HORIZONTAL COMPONENT @ BUOY FROM #3 PENDANTS
H4 = HORIZONTAL COMPONENT @ BUOY FROM #4 PENDANT
FV = VERTICAL COMPONENT FROM MOORING LINE
V1 = VERTICAL COMPONENT @ BUOY FROM PENDANT #1
V2 = VERTICAL COMPONENT @ BUOY FROM PENDANTS #2
V3 = VERTICAL COMPONENT @ BUOY FROM PENDANTS #3
V4 = VERTICAL COMPONENT @ BUOY FROM PENDANT #4
V5 = VERTICAL COMPONENT @ BUOY FROM PENDANTS #5
WL = WEIGHT OF LIQUID FLOATING BUOY

HEEL ANGLE OF BUOY

INPUT FOR 100' W.D. (MAX. CONDITIONS)

R1 = 15.
R2 = 17.
R3 = 11.5
W = 290.
C = 7.
D = 15.
E = 17.5
BK = 5.5
FH = 300.
H1 = 210.
H2 = 58.
H3 = 10.
H4 = 8.
FV = 0. (CASE I) 50. (CASE II) 100. (CASE III) 150. (CASE IV)
V1 = 68.
V2 = 42.
V3 = 15.5
V4 = 17.3
V5 = 24.
WL = 64.

NOTE: HEEL ANGLE IS FIGURED FOR FOUR CASES OF FV.

INPUT S[illegible] [illegible]TIFICATIONS
MCD 12504

J. RAY McDER[illegible]TT & CO., INC.
COMPUTER PROGRAM DOCUMENTATION

DATE	PROGRAM NO	USER GROUP NUMBER	SHEET PAGE	OF
10-28-65			12	

TITLE
SAMPLE DATA FOR BUOY HEEL ANGLE

	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
	15.	17.	11.5	2900.	7.	15.	17.5	5.5
	300.	210.	58.	10.	8.			
I	2.	68.	42.	16.5	17.3	24.	.069	
II	50.	〃〃〃	〃〃〃	〃〃〃〃	〃〃〃〃	〃〃〃	〃〃〃〃	
III	100.	〃〃〃	〃〃〃	〃〃〃〃	〃〃〃〃	〃〃〃	〃〃〃〃	
IV	150.	〃〃〃	〃〃〃	〃〃〃〃	〃〃〃〃	〃〃〃	〃〃〃〃	

SUBMITTED BY	PUNCHED BY	VERIFIED BY
ANDREWS	ANDREWS	

SHEET 13

BUOYANT FORCE		HEEL ANGLE °		
B =	540.1000	DEG =	8.646987	CASE I
B =	490.1000	DEG =	5.389638	CASE II
B =	440.1000	DEG =	2.423317	CASE III
B =	390.1000	DEG =	-.275415	CASE IV

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U. S. ARMY/ERDL
SHEET NO: 14
SUBJECT: MONO-MOORING SYSTEM - SAMPLE CALCULATIONS
NUMBER: JOB 56017
COMPUTER: ANDREWS
CHECKED BY:
DATE: 10-28-65

CHECK DRAFT OF BUOY UNDER PRELOAD

WT. OF BUOY + EQPT. = $\underline{290^K}$
WT. OF FOAM WITH NO COMPTS. BALLASTED = $\underline{29^K}$
VERTICAL FROM PRELOAD = 15.7(8) = $\underline{126^K}$

BUOYANCY FROM SKIRT AND RUBBER BUMPER = $\underline{41^K}$

TOTAL VERTICAL = 290 + 29 + 126 - 41 = $\underline{404^K}$

BUOYANCY / 1 = $\underline{41.6^K}$

DRAFT = $\frac{404}{41.6}$ = 9.71 FT. O.K.

CHECK DRAFT OF BUOY UNDER MAX. CONDITIONS & 300^K MOORING LOAD.

CASE I FV = 0

TOTAL VERTICAL = 540.1 - 41 = 499.1

DRAFT = $\frac{499.1}{41.6}$ = 12.0 FT. O.K.

CASE IV FV = 150

TOTAL VERTICAL = 390.1 - 41 = 349.1

DRAFT = $\frac{349.1}{41.6}$ = 8.5 FT. O.K.

DRAFT & FREEBOARD CALCULATIONS

CHECK POSITIVE FREEBOARD UNDER PRELOAD AND ALL COMPARTMENTS FLOODED

TOTAL VERTICAL = 290 + 126 + 29 = $\underline{445^K}$

TOTAL BUOYANCY

LOWER HALF OF BUOY	= 41.6 (7) =	291
UPPER HALF OF BUOY	= 20.8 (8) =	166
SKIRT AND RUBBER BUMPERS	=	41
TOTAL	=	$\underline{498^K}$

498 > 445 ∴ BUOY WILL HAVE POSITIVE FBD.

NOTE: FOR MAXIMUM WATER DEPTH OF 150' IT WAS NECESSARY TO CONSIDER REDUCTION IN THE VERTICAL COMPONENT OF THE CHAIN AT THE BUOY DUE TO THE INCREASED DRAFT. IT SHOULD ALSO BE NOTED THAT THE ROTATING DECK, MACHINERY, AND PARTS OF THE BUOY HULL MAY BE CONVERTED TO SUBMERSED WEIGHT IN LIEU OF AIR WEIGHT WHICH WILL FURTHER REDUCE THE BUOYANT FORCE REQUIRED TO MAINTAIN POSITIVE FREEBOARD.

BUOY

LOADS

BUOY HULL WAS DESIGNED FOR HYDROSTATIC WATER PRESSURE WITH TOP OF ROTATING DECK UNDER A 4' HEAD, WHICH RESULTS IN THE FOLLOWING LOADS:

BUOY BOTTOM - - 9.1 Psi BUOY TOP - - 2.67 Psi MACHINERY DECK - - 6.45 Psi

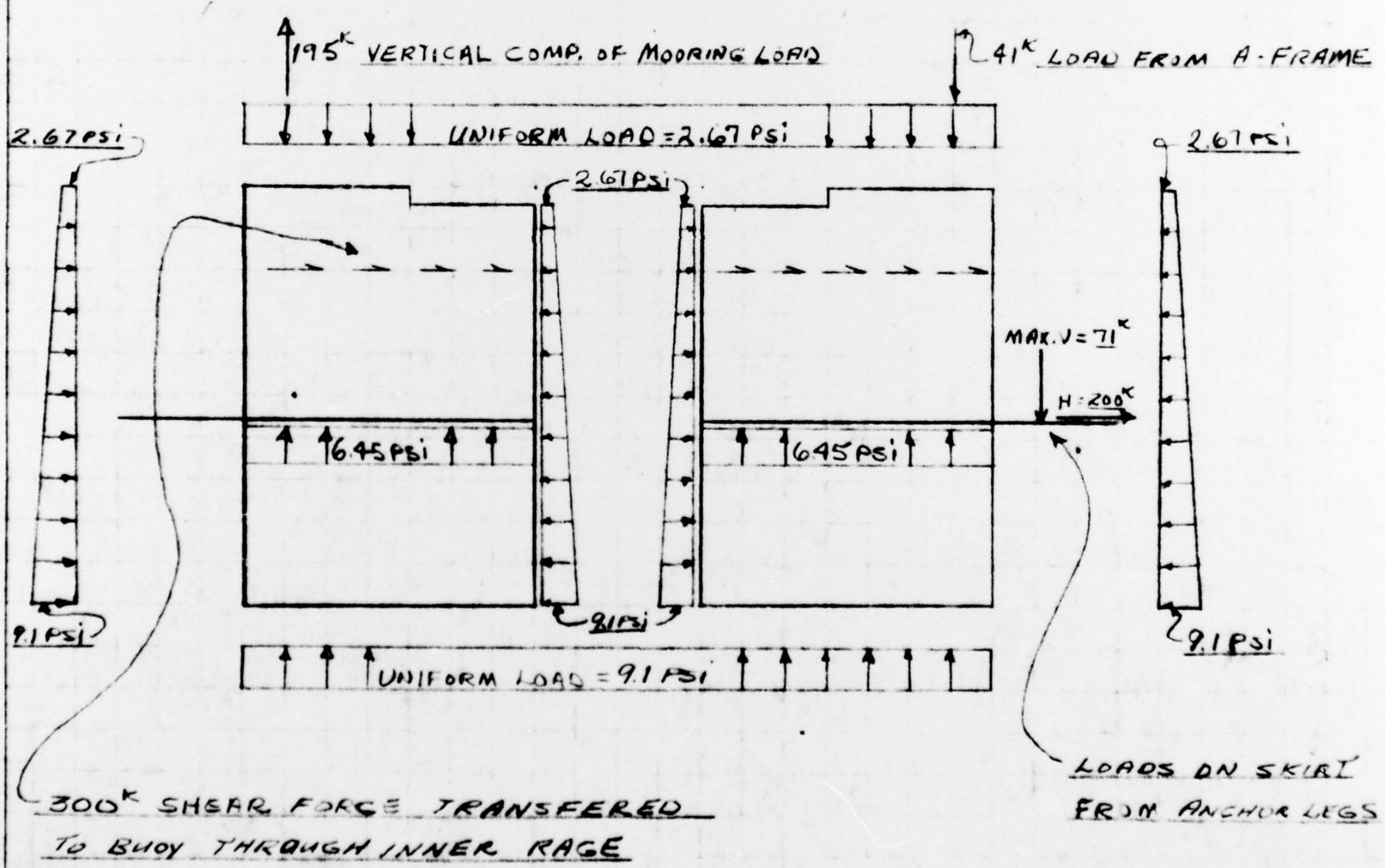


DIAGRAM OF LOADS APPLIED TO BUOY

BUOY WAS DESIGNED FOR LOADS AS NOTED, USING THE FOLLOWING MATERIAL WITH ALLOWABLE STRESSES AS NOTED.

ASTM A7 STEEL

TENSION -------- 20,000 PSI
BENDING ---------- 20,000 PSI
COMPRESSION ----- AS CALCULATED
SHEAR ---------- 13,000 PSI
BEARING -------- 30,000 PSI OR AS CALCULATED.

ASTM A36 STEEL

TENSION --------- 22,000 PSI
BENDING --------- 22,000 PSI
COMPRESSION ------ AS CALCULATED
SHEAR --------- 14,500 PSI
BEARING --------- 33,000 PSI OR AS CALCULATED

ASTM A242 & ASTM A441

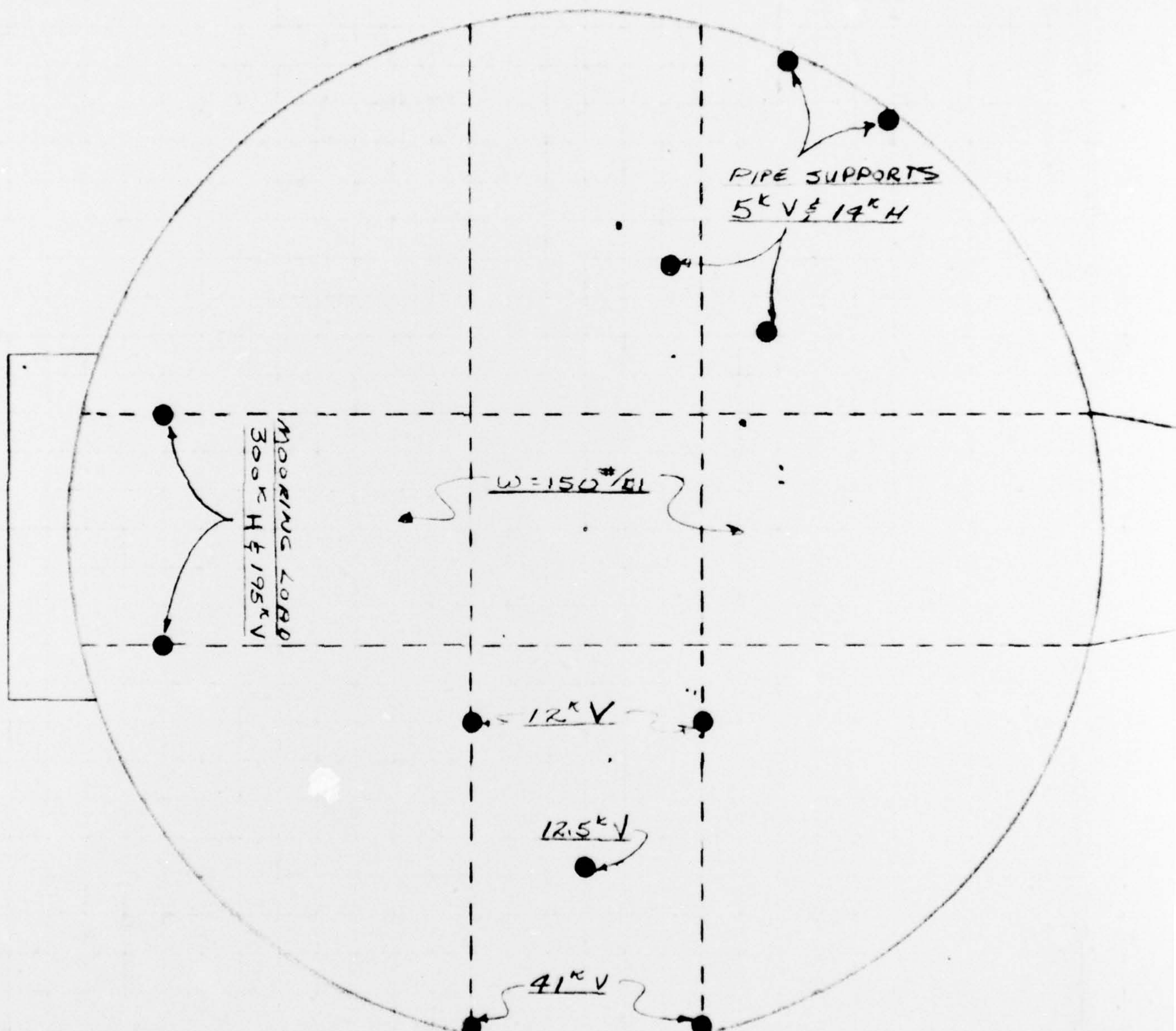
TENSION -------- 25,000 PSI
BENDING -------- 25,000 PSI
COMPRESSION ---- AS CALCULATED
SHEAR -------- 17,000 PSI
BEARING -------- 38,000 PSI OR AS CALCULATED

ENGINEERING DEPARTMENT COMPUTATION SHEET

MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY: U. S. ARMY / ERDL	SHEET NO: 16
SUBJECT: MONO-MOORING SYSTEM - DESIGN FACTORS	
DRAWING NUMBER: JOB 56017	COMPUTER: ANDREWS	CHECKED BY:	DATE: 10-29-65



PLAN VIEW OF ROTATING DECK

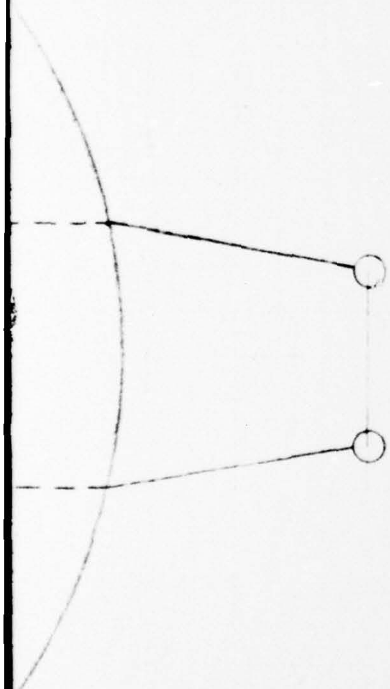
ROTATING DECK

DESIGN LOADS

TOTAL HORIZONTAL MOORING LOAD - - - - 300^K →
MAXIMUM VERTICAL COMPONENT - - - - - - - 195^K ↑
(DECK DESIGNED FOR 60% UNBALANCED MOORING LOAD)

VERTICAL REACTION FORWARD LEG A-FRAME - - 41^K ↓/LEG
VERTICAL REACTION BACK LEG OF A-FRAME - - 12^K ↑/LEG
VERTICAL REACTION FROM WINCH - - - - - - - 12.5^K ↑

VERTICAL REACTION FROM PIPES - - - - 5.0^K ↓/SUPPORT
MAXIMUM HORIZONTAL FROM PIPES - - - - - - 14^K/SUPPORT



DECK WAS DESIGNED FOR A UNIFORM LOAD OF 150 PSF PLUS THE CONCENTRATED LOAD AS NOTED ABOVE.

ALLOWABLE STRESSES

ALLOWABLE STRESSES USED WERE THOSE NOTED ON PG. 15 OF THE SAMPLE CALCULATIONS.

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
U.S. ARMY/ERDL			17
SUBJECT: MONO-MOORING SYSTEM - DESIGN FACTORS			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE
JOB. 56017	ANDREWS		10-27-65

MOORING LINES

LOADS

MAXIMUM HORIZONTAL MOORING LOAD --- 300^k

USE 65% UNBALANCED = 300(.65) = 195^k

MAX. HORIZONTAL COMPONENT/MOORING LINE = 195^k

RESULTANT @ 30° = $\frac{195}{.866}$ = 225^k/LINE

SAFETY FACTORS

ITEMS	SAFETY FACTORS
PAD-EYES ---------	USE ALLOWABLE STRESSES AS NOTED PG. 15
CHAIN ENDS & FITTINGS --	2.0 FOR PROOF LOAD OF CHAIN
WIRE ROPE & FITTINGS ---	2.0 FOR ULTIMATE STRENGTH OF W.R.
NYLON ROPE & FITTINGS ---	1.6 FOR ULTIMATE STRENGTH OF ROPE

.15
.R.
ROPE

ANCHOR SYSTEM

MAX. ANCHOR LOAD = 225^K

MAX. TENSION IN ANCHOR LEG ≈ 230^K

SAFETY FACTORS

ANCHORS - - - - - - - - - - - - - - 1.0 FOR 50' DRAG
ANCHOR CHAIN - - - - - - - - - - - 3.0 FOR PROOF LOAD OF CHAIN